

NASA CR-

140287

D2-118544-2

**DYNAMIC DOCKING TEST SYSTEM (DDTS)  
ACTIVE TABLE COMPUTER PROGRAM  
NASA ADVANCED DOCKING SYSTEM (NADS)**

(NASA-CR-140287) DYNAMIC DOCKING TEST  
SYSTEM (DDTS) ACTIVE TABLE COMPUTER  
PROGRAM NASA ADVANCED DOCKING SYSTEM  
(NADS) (Boeing Aerospace Co., Houston,  
Tex.) 136 p HC \$11.00

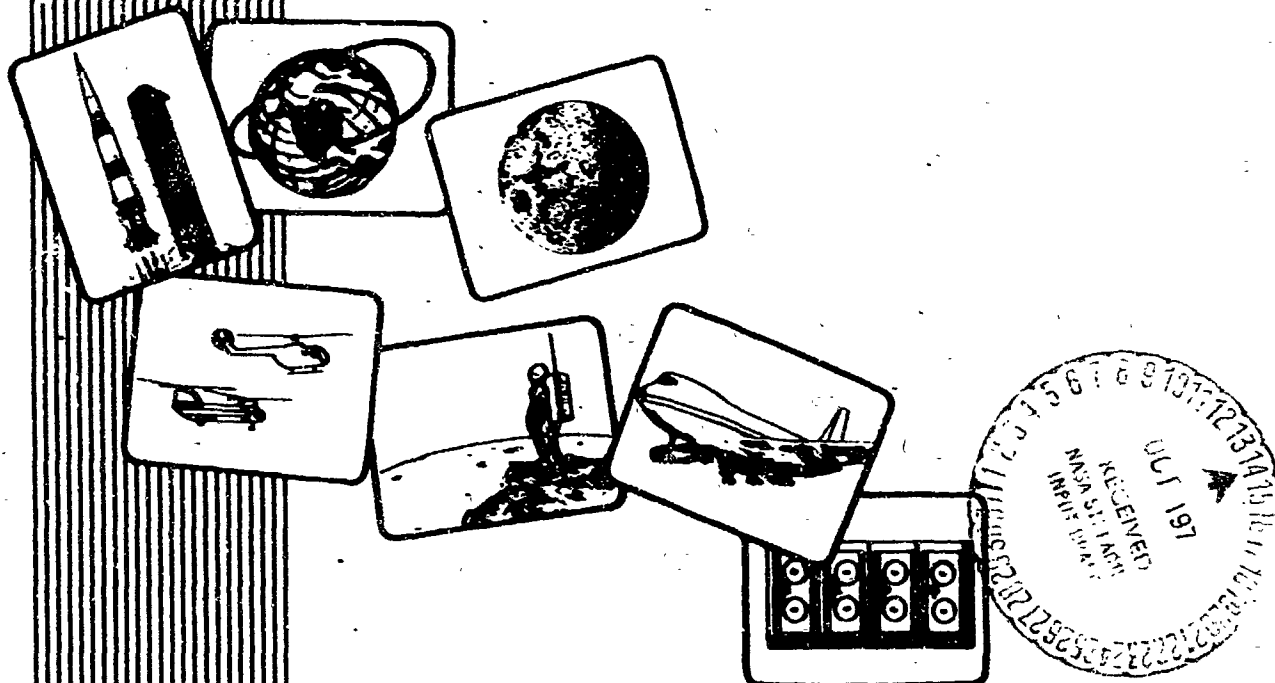
N74-34290

CSCD 22A

G3/30

Unclass

50341



THE **BOEING** COMPANY  
HOUSTON, TEXAS

August 30, 1974

DOCUMENT NO. D2-118544-2

DYNAMIC DOCKING TEST SYSTEM (DDTS) ACTIVE TABLE  
COMPUTER PROGRAM NASA ADVANCED DOCKING SYSTEM  
(NADS)

Contract NAS 9-13136

August 30, 1974

Prepared by

R. M. Gates  
R. E. Jantz

Approved by

*R. K. Nuno*

R. K. Nuno  
Technical Program Manager

BOEING AEROSPACE COMPANY  
Houston, Texas

D2-118544-2

REVISIONS

REV. SYM	DESCRIPTION	DATE	APPROVED

ABSTRACT

This document describes the computer program developed to describe the three-dimensional motion of the Dynamic Docking Test System (DDTS) active table. The input consists of inertia and geometry data, actuator structural data, forcing function data, hydraulics data, servo electronics data, and integration control data. The output consists of table responses, actuator bending responses, and actuator responses.

KEY WORDS

Docking Simulator  
Dynamic Docking Test System (DDTS)  
Hydraulic Actuator  
Mathematical Model  
Motion Simulator

## TABLE OF CONTENTS

<u>PARAGRAPH</u>		<u>PAGE</u>
	REVISIONS	ii
	ABSTRACT AND KEY WORDS	iii
	TABLE OF CONTENTS	iv
	LIST OF ILLUSTRATIONS	v
	REFERENCE	vi
1.0	GENERAL INFORMATION	1
1.1	COMPUTER SYSTEM	1
1.2	PURPOSE	1
1.3	LIMITATIONS	1
2.0	PROCEDURE	1
2.1	PROGRAM NAME	1
2.2	NOMENCLATURE	2
2.3	METHOD	6
3.0	INPUT/OUTPUT DESCRIPTION	16
3.1	INPUT DESCRIPTION AND PREPARATION	16
3.2	OUTPUT DESCRIPTION	22
3.3	ERROR MESSAGES	25
4.0	OPERATING INFORMATION	26
4.1	PROGRAM AND DATA SETUP	26
4.2	RUN INFORMATION	26
5.0	PROGRAMING INFORMATION	26
5.1	FLOW CHARTS	26
5.2	SYSTEM STRUCTURE	41
5.3	LIBRARY SUBROUTINES	41
5.4	PROGRAM LISTING	41
5.5	SAMPLE PROBLEM	102

ILLUSTRATIONS

<u>FIGURE</u>		<u>PAGE</u>
1	DDTS Simulator Facility	7
2	Active Table Coordinate Systems	8
3	Mass Matrix	10
4	Servo Electronics Block Diagram	14

D2-118544-2

REFERENCE

Boeing Document D2-118544-1, "Mathematical Model for the Simulation of Dynamic Docking Test System Active Table Motion," August 30, 1974.

## 1.0 GENERAL INFORMATION

### 1.1 COMPUTER SYSTEM

This program was written in FORTRAN V language for use on the UNIVAC 1108 computer with the EXEC II operating system. The program can easily be converted to the EXEC 8 operating system. The plotted output is done on the Stromberg Datagraphix's SD-4060 microfilm plotter.

### 1.2 PURPOSE

The program simulates the motions of the NASA JSC Dynamic Docking Test System (DDTS) active table. Given a description of the table mass and geometry, the actuators, the hydraulic system, the electronics, and the forcing function, the program outputs time-histories of table responses, actuator bending data, and actuator responses. Responses to the following input forcing functions are calculated:

- a. Step velocity command
- b. Sinusoidal position commands
- c. Step external force on table c.g.
- d. Sinusoidal external force on table c.g.

### 1.3 LIMITATIONS

Forcing functions are limited to those listed in Paragraph 1.2. Dynamics of the simulator due to docking are not modeled. Actuator control system components are limited to those shown in Figure 4. In the actual DDTS, there are notch filters in both the velocity command line and the forward loop which are not included in this simulation.

## 2.0 PROCEDURE

### 2.1 PROGRAM NAME

The program acronym is NADS from NASA Advanced Docking System.



## 2.2 NOMENCLATURE

## Nomenclature for NADS

<u>Program</u>	<u>Engineering</u>	<u>Description</u>
A	[A]	Transformation matrix from table to inertial coordinates
A	$A_1, A_2$	"Push" and "pull" stroke working areas of actuators
AA	$\ddot{l}_p$	Actuator acceleration
AL	$l_p$	Actuator length
ALPHA	$\alpha$	Break frequency of first order filter
AL3D	$\ddot{\ddot{l}}_p$	Actuator jerk
AV	$\dot{l}_p$	Actuator velocity
BETA	$\beta$	Break frequency of first order filter
BETA E	$\beta_e$	Equivalent hydraulic system bulk modulus
BP	$B_p$	Viscous damping coefficient of actuator
C	-	Column of generalized forces for equations of motion solution
CAA	$\ddot{l}_c$	Commanded actuator acceleration
CAL	$l_c$	Commanded actuator length
CAV	$\dot{l}_c$	Commanded actuator velocity
CP	$C_p$	Leakage coefficient across piston seals
DLTAI	$\Delta x_I, \Delta y_I,$ $\Delta z_I, \Delta \theta,$ $\Delta \psi, \Delta \phi$	Sinusoidal amplitudes of translational commands for table c.g. and of table Euler angles
EIR	$EI_r$	Bending modulus of piston rod
FF	$F_f$	Coulomb friction force of actuator
FH	$F_H$	Total hydraulic and friction forces acting on pistons

## 2.2 (Continued)

## Nomenclature for NADS (continued)

<u>Program</u>	<u>Engineering</u>	<u>Description</u>
FMEXT	$F_{EXT}, M_{EXT}$	External forces and moments
FP	$F_p$	Net forces on actuator piston
FRQNCY	$\omega_c$	Command signal frequency
IAC	$I_{AC}$	Mass moment of inertia of cylinder (excluding the mass of the piston) about floor swivel joint
IFIRST	-	Initialization indicator for mass matrix and geometry
IM	-	Mass matrix and geometry update option indicator
INDKTR	-	Stroking or matrix inversion error indicator to terminate the integration process
INNER	$I_{xx}, I_{yy},$ $I_{zz}, I_{xy},$ $I_{xz}, I_{yz}$	Moments and products of inertia
IPLOPT	-	Plot option indicator
IPROPT	-	Print option indicator
IXF	-	External force and moment option indicator
KC	$K_c$	Valve pressure flow coefficient
KF	$K_f$	Displacement feedback and command gain
KG	$K_g$	Electronics and valve forward loop gain
KPF	$K_{pf}$	Pressure feedback loop gain
KR	$K_r$	Velocity feedback loop gain
KRC	$K_{rc}$	Velocity command gain
LC	$l_c$	Distance from floor swivel to center line of piston rod seal at end of cylinder

## 2.2 (Continued)

## Nomenclature for NADS (continued)

<u>Program</u>	<u>Engineering</u>	<u>Description</u>
LPM	$l_{pm}$	Maximum stroke of actuators
LR	$l_r$	Length of piston rod
LO	$l_o$	Retracted length (between swivel joints) of actuators
M	$M, M^{-1}$	Mass matrix and mass matrix inverse
MH	$M_H$	Moment acting about table c.g. from hydraulic and friction forces
ML	$m_l$	Effective rigid lateral mass of actuator assembly
MP	$m_p$	Mass of piston rod and piston
MQ	$m_q$	Effective bending mass lumped at rod seal of cylinder
MT	$m_t$	Table mass
NFREQ	-	Number of table displacement frequency cases
NFFREQ	-	Number of external force and moment frequency cases
NPLTS	-	Number of plotted time points
OMEGA	$\omega_1, \omega_2$	Break frequencies of first order filters
OMEGAC	$\omega_c$	Displacement command signal frequency
OMEGAE	$\omega_e$	Actuator bending frequency
OMEGAF	$\omega_f$	Frequency of sinusoidal external forces and moments
OMEGAS	$\omega_s$	Frequency of second order filter on displacement and velocity feedbacks
OMEGAV	$\omega_v$	Frequency of valve dynamics
OMEGPF	$\omega_{pf1}, \omega_{pf2}$	Break frequencies of pressure feedback filters

## 2.2. (Continued)

## Nomenclature for NADS (continued)

<u>Program</u>	<u>Engineering</u>	<u>Description</u>
OUTFRQ	-	Output frequency for printing and plotting
PS	$P_s$	Supply pressure
RS	$r_s$	Inertial vector components of actuator length
RXA	$r_{xa}$	X axis table station of actuator swivel joints with respect to the table c.g.
RYZA	$r_{ya}, r_{za}$	Y, Z table coordinates of swivel joints with respect to the table c.g.
T	[T]	Transformation matrix transforming vectors from table coordinates to local actuator coordinates
TCGCO	$X_{I_0}, Y_{I_0}, Z_{I_0}$	Initial inertial coordinates of table c.g.
TDIC	$\{R_{I_c}\}, \{\dot{R}_{I_c}\}, \{\theta_{I_c}\}, \{\dot{\theta}_{I_c}\}$	Time dependent inertial commands
TEAO	$\theta_0, \psi_0, \phi_0$	Initial Euler angles of the table coordinate system with respect to the inertial system
TEND	-	Last integration time
TIME	t	Time
TITLE	-	Title to be printed at top of first page of output
TPLOT	-	Time point at or after which output for plots is made
TPRINT	-	Time point at or after which printed output is made
TSTART	-	First integration time

## 2.2 (Continued)

## Nomenclature for NADS (concluded)

<u>Program</u>	<u>Engineering</u>	<u>Description</u>
VO	$V_o$	Initial hydraulic volumes of push and pull strokes of fully retracted actuator
X	-	Variable array (output by integration procedure)
XDOT	-	Derivative array
XO	$x_o$	Initial condition array
YZF	$y_f, z_f$	Y and Z inertial coordinates of floor swivel joints
ZETA E	$\zeta_e$	Damping constant for actuator bending
ZETA S	$\zeta_s$	Damping constant of second order filter on displacement and velocity feedbacks
ZETA V	$\zeta_v$	Damping constant of valve dynamics

## 2.3 METHOD

This section contains a brief description of the physical system for which the program was written and the mathematical equations used to describe the motion of the system. The equations are described in detail in the referenced document.

The DOTS active table is a triangular platform supported by six hydraulic actuators as shown in Figure 1. The table is capable of six-degree-of-freedom motion controlled by the six actuators.

Three coordinate systems are used to describe the motion of the table and actuators. These coordinate systems are shown in Figure 2. The inertial coordinate system origin is on the simulator centerline in the plane of the floor swivel joints. Table motion commands and responses are expressed in the inertial coordinate system. Table coordinates are body fixed coordinates whose origin is at the table center of gravity. Actuator coordinates are used to describe actuator motions.

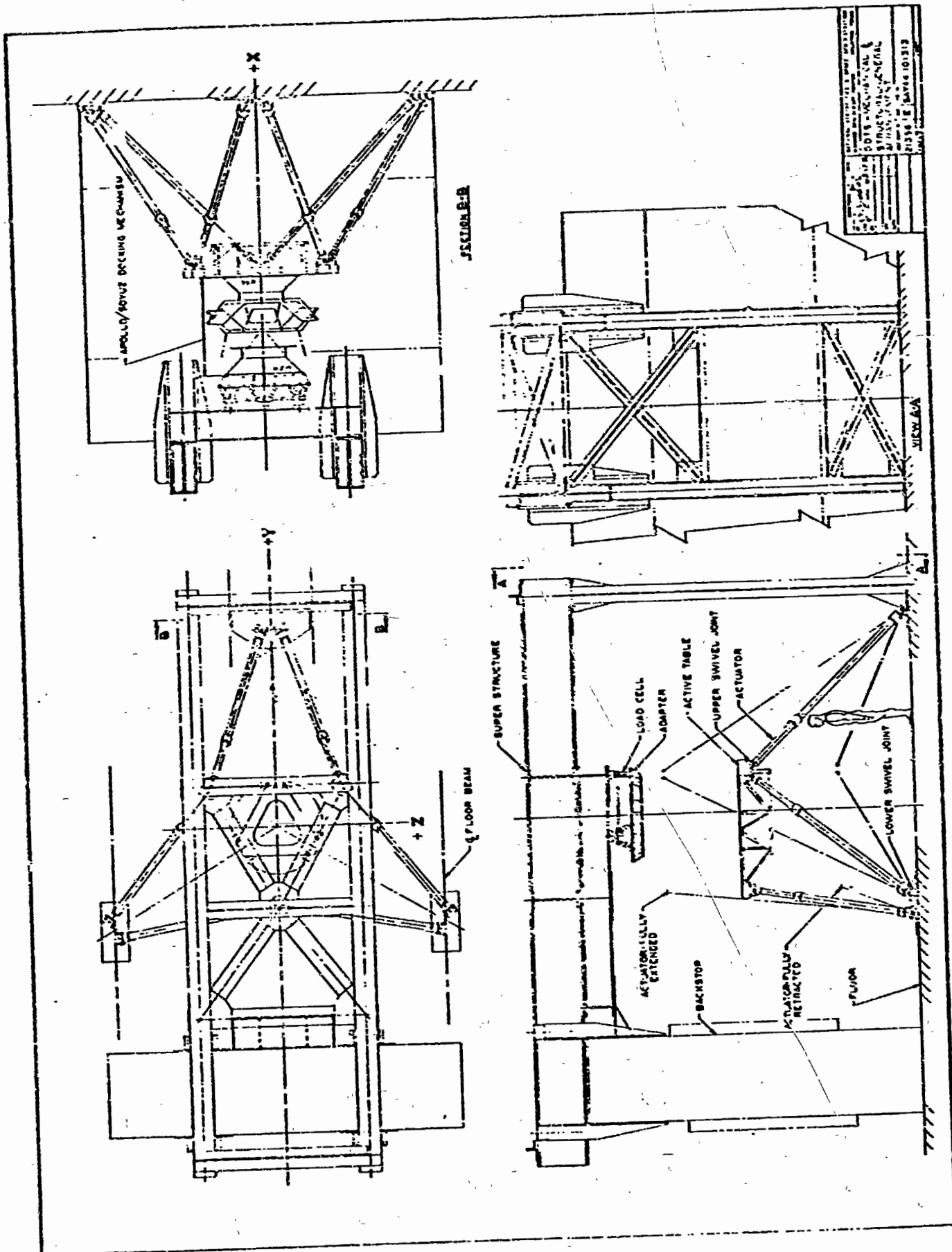


Figure 1. DOTS Simulator Facility

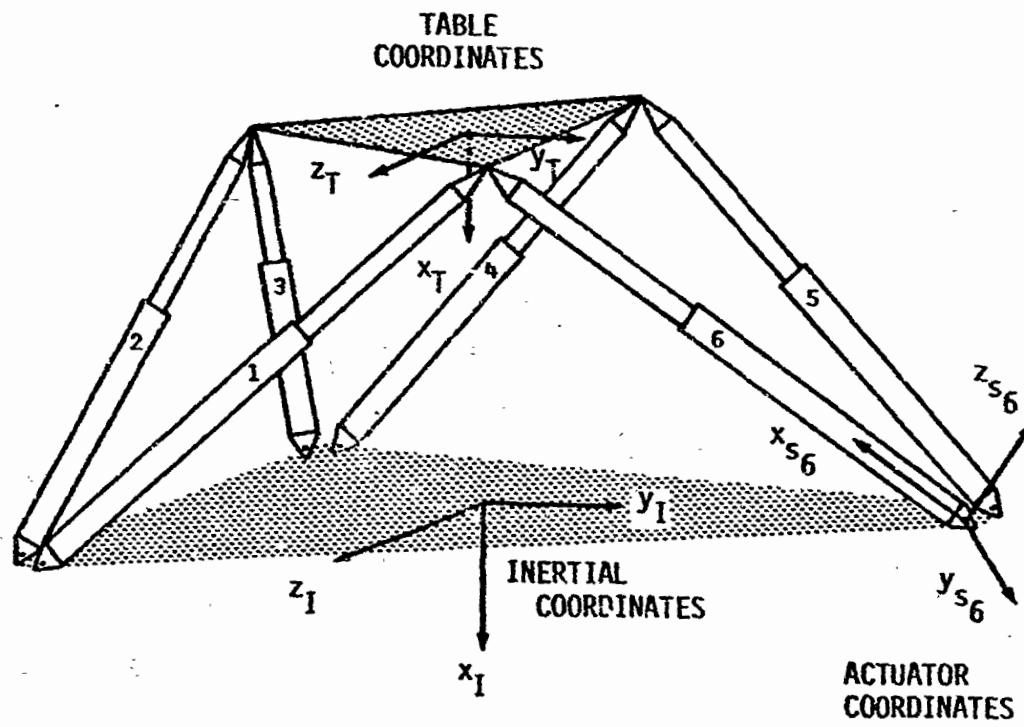


Figure 2. Active Table Coordinate Systems

## 2.3 (Continued)

Table equations of motion are written in the body fixed table coordinates as follows:

$$\{\ddot{x}\} = [M]^{-1} \{C\} \quad (1)$$

where:  $\{\ddot{x}\}$  is a column of accelerations for each degree of freedom (six degrees of freedom for the table and two elastic degrees of freedom for each actuator)

$[M]$  is the 18 x 18 coupled mass matrix

$\{C\}$  is a column of generalized forces for each degree of freedom

The mass coupling effects of the actuators due to table motions are determined by Lagrange's method. The three-dimensional rigid motions of the actuators are completely constrained (i.e., they are dependent upon the table motions). The mass matrix is shown in Figure 3 in upper triangular form.

The column of generalized forces includes the velocity terms in the equations of motion, the total forces exerted on the table by the actuators, externally applied forces and moments, and actuator bending stiffness and damping.

$$\begin{pmatrix} \ddot{x}_T \\ \ddot{y}_T \\ \ddot{z}_T \\ \vdots \\ \ddot{\omega}_x \\ \ddot{\omega}_y \\ \ddot{\omega}_z \\ \vdots \\ \ddot{y}_{e_i} \\ \vdots \\ \ddot{z}_{e_i} \end{pmatrix} = [M]^{-1} \left\{ \begin{array}{l} -m_T \begin{bmatrix} 0 & -\omega_z & \omega_y \\ \omega_z & 0 & -\omega_x \\ -\omega_y & \omega_x & 0 \end{bmatrix} \begin{pmatrix} \dot{x}_T \\ \dot{y}_T \\ \dot{z}_T \end{pmatrix} + \begin{pmatrix} F_{H_x} \\ F_{H_y} \\ F_{H_z} \end{pmatrix} + \begin{pmatrix} F_{E_x} \\ F_{E_y} \\ F_{E_z} \end{pmatrix} \\ \vdots \\ - \begin{bmatrix} 0 & -\omega_z & \omega_y \\ \omega_z & 0 & -\omega_x \\ -\omega_y & \omega_x & 0 \end{bmatrix} \begin{bmatrix} \dot{x}_T \\ \dot{y}_T \\ \dot{z}_T \end{bmatrix} + \begin{pmatrix} M_{H_x} \\ M_{H_y} \\ M_{H_z} \end{pmatrix} + \begin{pmatrix} M_{E_x} \\ M_{E_y} \\ M_{E_z} \end{pmatrix} \\ \vdots \\ -2\zeta_e \omega_{e_i} m_{q_i} \dot{y}_{e_i} - \omega_{e_i}^2 m_{q_i} y_{e_i} \\ \vdots \\ -2\zeta_e \omega_{e_i} m_{q_i} \dot{z}_{e_i} - \omega_{e_i}^2 m_{q_i} z_{e_i} \end{array} \right\} \quad (2)$$



[illegible]

REPRODUCIBILITY OF THE  
ORIGINAL PAGE IS POOR.

**Figure 3. Mass Matrix**

## 2.3 (Continued)

The Euler angles  $\theta$ ,  $\psi$ ,  $\phi$  are used to transform velocities in the table coordinate system to the inertial coordinate system

$$\begin{pmatrix} \dot{x}_I \\ \dot{y}_I \\ \dot{z}_I \end{pmatrix} = [A] \begin{pmatrix} \dot{x}_T \\ \dot{y}_T \\ \dot{z}_T \end{pmatrix} \quad (3)$$

$$\begin{pmatrix} \dot{\theta} \\ \dot{\psi} \\ \dot{\phi} \end{pmatrix} = \begin{bmatrix} 0 & \frac{\cos\phi}{\cos\psi} & -\frac{\sin\phi}{\cos\psi} \\ 0 & \sin\phi & \cos\phi \\ 1 & -\cos\phi\tan\psi & \sin\phi\tan\psi \end{bmatrix} \begin{pmatrix} \omega_x \\ \omega_y \\ \omega_z \end{pmatrix} \quad (4)$$

where:

$$[A] = \begin{bmatrix} C\theta \cdot C\psi & -C\phi \cdot C\theta \cdot S\psi + S\theta \cdot S\phi & S\phi \cdot C\theta \cdot S\psi + C\phi \cdot S\theta \\ S\psi & C\phi \cdot C\psi & -S\phi \cdot C\psi \\ -C\psi \cdot C\phi & C\phi \cdot S\theta \cdot S\psi + S\phi \cdot C\theta & -S\phi \cdot S\theta \cdot S\psi + C\phi \cdot C\theta \end{bmatrix} \quad (5)$$

C = cosine

S = sine

Each actuator is modeled as a flexible rod with pinned ends and is free to bend in its first lateral mode in two orthogonal directions.

Hydraulic forces are calculated using nonlinear hydraulic flow equations:

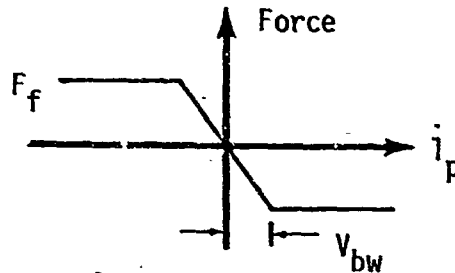
$$\begin{aligned} \dot{p}_1 &= \frac{\beta_e}{V_1} \left[ Q_o - 2K_c p_1 - C_p (p_1 - p_2) - A_1 \dot{i}_p \right] \\ \dot{p}_2 &= \frac{\beta_e}{V_2} \left[ -Q_o - 2K_c p_2 + C_p (p_1 - p_2) + A_2 \dot{i}_p \right] \end{aligned} \quad (6)$$

## 2.3 (Continued)

Piston forces calculated include the effects of viscous damping,  $B_p$ , and coulomb friction,  $F_f$ . For each actuator:

$$F_p = A_1 p_1 - A_2 p_2 - B_p \dot{i}_p - C_F F_f \quad (7)$$

The coefficient  $C_F$  is used to avoid a discontinuity at zero velocity.



$$\text{If } |\dot{i}_p| \geq v_{bw}, \text{ then } C_F = \frac{\dot{i}_p}{|\dot{i}_p|}$$

(8)

$$\text{If } |\dot{i}_p| < v_{bw}, \text{ then } C_F = \frac{\dot{i}_p}{v_{bw}}$$

Total hydraulic actuator forces and moments are then calculated for the equations of motion as follows:

$$\begin{Bmatrix} F_{H_x} \\ F_{H_y} \\ F_{H_z} \end{Bmatrix} = \begin{Bmatrix} \sum_{i=1}^6 F_{p_i} T_{i11} \\ \sum_{i=1}^6 F_{p_i} T_{i12} \\ \sum_{i=1}^6 F_{p_i} T_{i13} \end{Bmatrix} \quad (9)$$

## 2.3 (Continued)

$$\begin{Bmatrix} M_{H_x} \\ M_{H_y} \\ M_{H_z} \end{Bmatrix} = \begin{Bmatrix} \sum_{i=1}^6 F_{p_i} \left( -T_{i12} r_{za_i} + T_{i13} r_{ya_i} \right) \\ \sum_{i=1}^6 F_{p_i} \left( T_{i11} r_{za_i} - T_{i13} r_{xa_i} \right) \\ \sum_{i=1}^6 F_{p_i} \left( -T_{i11} r_{ya_i} + T_{i12} r_{xa_i} \right) \end{Bmatrix} \quad (10)$$

where the terms  $T_{i11}$ ,  $T_{i12}$ , ... etc. are the terms in the transformation from table coordinates to local actuator coordinates:

$$[T_i] = [T_{I_i}]^T [A] \quad (11)$$

$[T_{I_i}]$  is the transformation from actuator coordinates to inertial coordinates.

The servo electronics consist of actuator position and rate command signals and the electronic components shown in Figure 4. The use of the forward loop compensation network, the valve dynamics representation, and the position and rate feedback filter are optional. If  $\beta$ , for example, is input as a value less than unity, then the forward loop compensation network is not included in the simulation. Similarly, the valve dynamics and position feedback filter are neglected if  $\omega_v < 1$  and  $\omega_s < 1$ , respectively.

Table motion commands are input in the inertial coordinate system and are transformed to commands to the six actuators as follows:

Define  $[A_c]$  as the  $[A]$  matrix with the angles  $\theta, \psi, \phi$  replaced with the commanded Euler angles  $\theta_c, \psi_c, \phi_c$ . Then the commanded inertial components

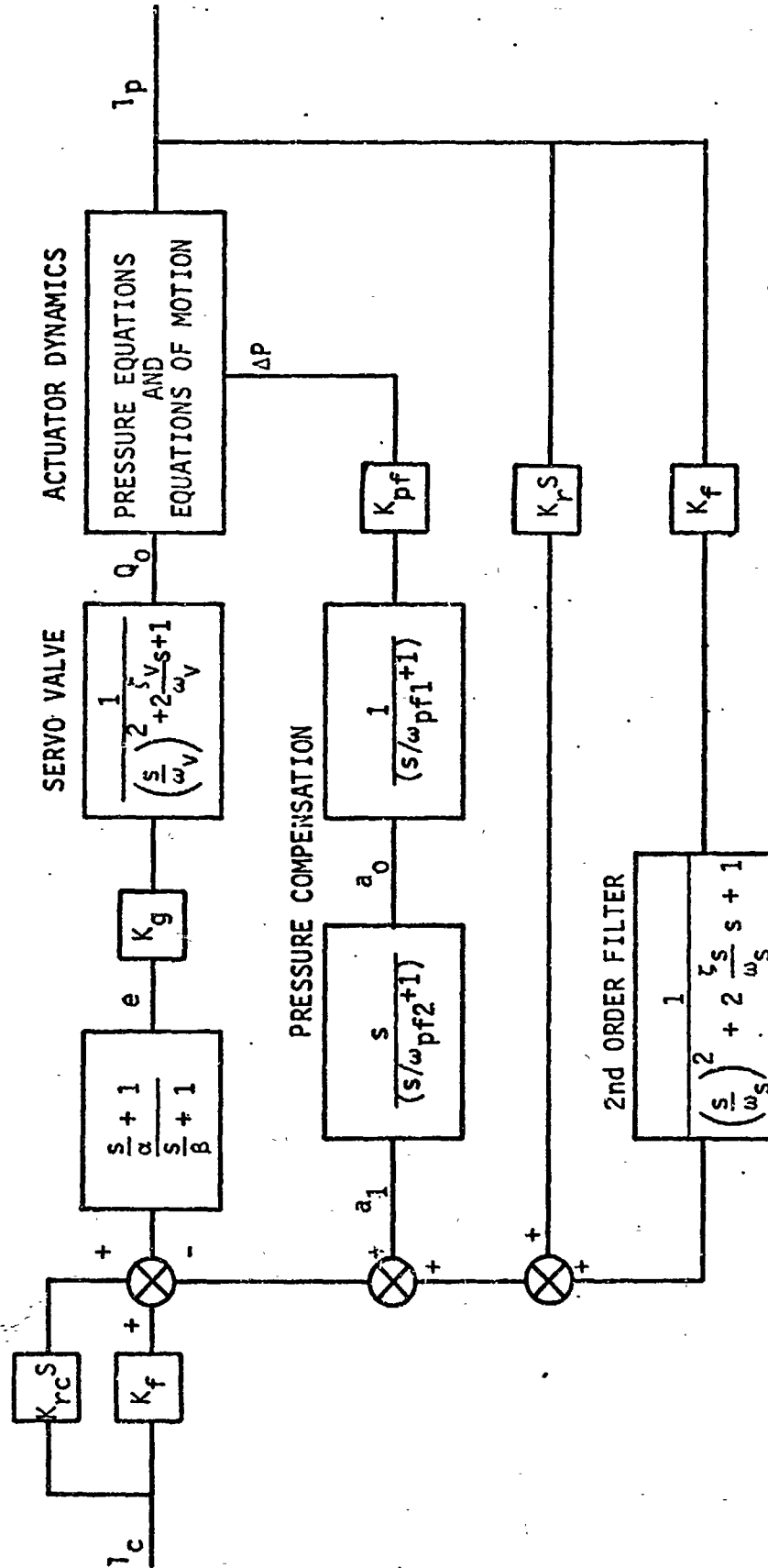


Figure 4. Servo Electronics Block Diagram

## 2.3 (Continued)

of actuator length are:

$$\begin{Bmatrix} r_{sx_i} \\ r_{sy_i} \\ r_{sz_i} \end{Bmatrix} = \begin{Bmatrix} x_{I_c} \\ y_{I_c} \\ z_{I_c} \end{Bmatrix} + [A_c] \begin{Bmatrix} r_{xa_i} \\ r_{ya_i} \\ r_{za_i} \end{Bmatrix} - \begin{Bmatrix} 0 \\ y_{f_i} \\ z_{f_i} \end{Bmatrix} \quad (12)$$

and the commanded inertial velocities of the table/servo attachment points are:

$$\begin{Bmatrix} \dot{r}_{sx_i} \\ \dot{r}_{sy_i} \\ \dot{r}_{sz_i} \end{Bmatrix} = \begin{Bmatrix} \dot{x}_{I_c} \\ \dot{y}_{I_c} \\ \dot{z}_{I_c} \end{Bmatrix} + [A_c] \begin{bmatrix} 0 & -\omega_{z_c} & \omega_{y_c} \\ \omega_{z_c} & 0 & -\omega_{x_c} \\ -\omega_{y_c} & \omega_{x_c} & 0 \end{bmatrix} \begin{Bmatrix} r_{xa_i} \\ r_{ya_i} \\ r_{za_i} \end{Bmatrix} \quad (13)$$

where:

$$\begin{Bmatrix} \omega_{x_c} \\ \omega_{y_c} \\ \omega_{z_c} \end{Bmatrix} = \begin{bmatrix} 1 & 0 & S\psi_c \\ 0 & S\phi_c & C\psi_c \cdot C\phi_c \\ 0 & C\phi_c & -C\psi_c \cdot S\phi_c \end{bmatrix} \begin{Bmatrix} \dot{\phi}_c \\ \dot{\psi}_c \\ \dot{\theta}_c \end{Bmatrix} \quad (14)$$

Then the commanded actuator lengths and velocities are:

$$l_{c_i} = \sqrt{r_{sx_i}^2 + r_{sy_i}^2 + r_{sz_i}^2} \quad (15)$$

$$\dot{l}_{c_i} = \frac{1}{l_{c_i}} [r_{sx_i} \cdot \dot{r}_{sx_i} + r_{sy_i} \cdot \dot{r}_{sy_i} + r_{sz_i} \cdot \dot{r}_{sz_i}] \quad (16)$$

### 3.0 INPUT/OUTPUT DESCRIPTION

#### 3.1 INPUT DESCRIPTION AND PREPARATION

Card 1     Format 13A6,A2

TITLE

TITLE - 80-character title to be printed on the top of the first page of output

#### INERTIA AND GEOMETRY DATA

Card 2     Format E12.6

MT

MT - Table mass

Card 3     Format 6E12.6

(INER(I), I=1,6)

INER - Table moments and products of inertia

(1) -  $I_{xx}$

(2) -  $I_{yy}$

(3) -  $I_{zz}$

(4) -  $I_{xy}$

(5) -  $I_{xz}$

(6) -  $I_{yz}$

Card 4     Format E12.6

RXA

RXA - X table station of actuator swivel joints w.r.t. table c.g.

## 3.1 (Continued)

Card 5      Format 6E12.6

((RYZA(J,I),J=1,2),I=1,6)

RYZA(1,I) - y-table coordinate of I'th swivel joint w.r.t.  
table c.g.RYZA(2,I) - Z-table coordinate of I'th swivel joint w.r.t.  
table c.g.Card 6      Format 6E12.6

((YZF(J,I),J=1,2),I=1,6)

YZF(1,I) - y-inertial coordinate of I'th floor swivel joint

YZF(2,I) - Z-inertial coordinate of I'th floor swivel joint

## ACTUATOR STRUCTURAL DATA

Card 7      Format 6E12.6

ZETA E,MP,IAC,LC,LR,LO,EIR,LPM

ZETA E - Actuator bending damping constant

MP - Mass of rod and piston

IAC - Moment of inertia of cylinder about floor swivel joint

LC - Distance from floor swivel to center line of piston rod  
seal at end of cylinder

LR - Length of piston rod

LO - Retracted length of actuator

EIR - Bending modulus of piston rod

LPM - Maximum stroke of actuator

Note: The data above occupy two cards.



## 3.1 (Continued)

## FORCING FUNCTION DATA

Card 8      Format 6E12.6

(TCGCO(I),I=1,3),(TEAO(I),I=1,3)

TCGCO - Initial inertial coordinates of table c.g.

TEAO - Initial Euler angles of table coordinate system w.r.t.  
inertial system (rad.)Card 9      Format 4I4

IM,NFREQ,IXF,NFFREQ

IM - Mass matrix and geometry update option

= 0, do not update after initialization

= 1, update throughout time span

NFREQ - Number of displacement frequency cases to run (max. = 18)  
(see note after Card 11)

IXF - External force and moment option

= 0, no external forces or moments

= 1, constant external forces and moments are to be applied  
to the table c.g.

= 2, external forces and moments are sinusoidal

NFFREQ- Number of external force and moment frequencies (max. = 18)

Card 10      Format 6E12.6

(OMEGAC(I),I=1,NFREQ)

OMEGAC - Displacement command signal frequency (rad./sec.)

If OMEGAC(I) < 0, the command amplitudes (Card 11) are  
assumed to be step velocities.Card 11      Format 6E12.6

(DLTAI(I),I=1,6)

## 3.1 (Continued)

DLTAI - Sinusoidal amplitudes of X, Y and Z commands for table c.g., displacement and table Euler angles,  $\theta$ ,  $\psi$  and  $\phi$  (if OMEGAC > 0) or step velocities (if OMEGAC < 0)

Note: Due to the interaction of Cards 10 and 11, it is logical that if one OMEGAC(I) is less than or equal to zero they must all be. Therefore, it is logical that NFREQ should be only one in that case.

If IXF=0, skip the next two cards

Card 12      Format 6E12.6

(FMEXT(I), I=1,6)

FMEXT - Magnitude of external forces and moments applied to the table c.g.

If IXF=1, skip the next card

Card 13      Format 6E12.6

(OMEGAF(I), I=1, NFREQ)

OMEGAF = Frequencies of sinusoidal external forces and moments (rad./sec.)

## HYDRAULICS DATA

Card 14      Format 3E12.6

PS, BETAE, KC

PS      - Supply pressure

BETAE - Equivalent system bulk modulus

KC      - Valve pressure flow coefficient

Card 15      Format 6E12.6

(CP(I), I=1,6), (BP(I), I=1,6)

3.1 (Continued)

CP - Leakage coefficient across piston seals for each actuator

BP - Actuator viscous damping coefficient for each actuator

Note: The data above occupy two cards.

Card 16      Format 4E12.6

(A(I), I=1,2) (VO(I), I=1,2)

A - Actuator push and pull stroke working areas

VO - Initial hydraulic volumes of fully retracted actuator

Card 17      Format 6E12.6

(FF(I), I=1,6)

FF - Coulomb friction force of each actuator

ELECTRONICS DATA

Card 18      Format 6E12.6

(KG(I), I=1,6)

KG - Electronics and valve forward loop gain

Card 19      Format 6E12.6

(KF(I), I=1,6)

KF - Displacement feedback and command gain

Card 20      Format 6E12.6

(KR(I), I=1,6)

KR - Velocity feedback loop gain

Card 21      Format 6E12.6

(KPF(I), I=1,6)

KPF - Pressure feedback loop gain

## 3.1 (Continued)

Card 22      Format 6E12.6

(KRC(I),I=1,6)

KRC - Velocity command gain

Card 23      Format 4E12.6

ALPHA,BETA,(OMEGPF(I),I=1,2)

ALPHA -  $\alpha$ BETA -  $\beta$ OMEGPF -  $\omega_{PF1}$  and  $\omega_{PF2}$ 

}	Break frequencies of first order filters (rad./sec.)
---	---

Card 24      Format 6E12.6

ZETAS,OMEGAS,ZETAV,OMEGAV

ZETAS - Damping constant of second order filter on displacement  
and velocity feedbacksOMEGAS - Frequency of the displacement and velocity feedback filter  
(rad./sec.)

ZETAV - Damping constant of valve dynamics

OMEGAV - Frequency of the valve dynamics (rad./sec.)

## INTEGRATION CONTROL DATA

Card 25      Format 4E12.6,2I5

TSTART,TEND,(OUTFRQ(I),I=1,2),IPROP1,IPLOPT

TSTART - Start time

TEND - Stop time

OUTFRQ(1) - Output frequency for printing ( $\Delta t$ , sec.)OUTFRQ(2) - Output frequency for plotting ( $\Delta t$ , sec.)

### 3.1 (Continued)

IPROPT - Print option

IPLOPT - Plot option

Note: IPROPT and IPLOPT are of the form  $I_1 I_2 I_3 I_4$  where  $I_i$  is the group number of the i'th group of data to be printed. These groups are explained in the next paragraph, Output Description.

Cards 1 through 25 may be repeated as many times as desired.

### 3.2 OUTPUT DESCRIPTION

The output includes printed listings and plots of responses versus time. These responses are divided into four groups:

#### Group 1 - Table Response Data

- a. Incremental inertial motions of the table c.g.
- b. Incremental angular motions
- c. Incremental velocities of the table c.g.
- d. Euler angle rates
- e. Table position errors

#### Group 2 - Actuator Bending Data

- a. Bending frequencies of the actuators
- b. Y and Z lateral elastic displacements at cylinder rod seal

#### Group 3 - Actuator Responses

- a. Actuator strokes
- b. Actuator velocities
- c. Actuator position error
- d. Net forces on the actuator pistons

## 3.2 (Continued)

Group 4 - Complete Derivative and Variable Arrays (may not be plotted)

The variables and their derivatives (indexed by row) are listed below.

<u>Index</u>	<u>Derivative</u>	<u>Variable</u>	<u>Variable Definition</u>
1	$\ddot{x}_T$	$\dot{x}_T$	Table c.g. velocities
2	$\ddot{y}_T$	$\dot{y}_T$	
3	$\ddot{z}_T$	$\dot{z}_T$	
4	$\dot{\omega}_x$	$\omega_x$	Table rotational rates
5	$\dot{\omega}_y$	$\omega_y$	
6	$\dot{\omega}_z$	$\omega_z$	
7	$\ddot{y}_{e1}$	$\dot{y}_{e1}$	Lateral bending velocities of actuator along $y_{s_i}$ axis
:	$\vdots$	$\vdots$	
12	$\ddot{y}_{e6}$	$\dot{y}_{e6}$	
13	$\ddot{z}_{e1}$	$\dot{z}_{e1}$	Lateral bending velocities along $z_{s_i}$ axis
:	$\vdots$	$\vdots$	
18	$\ddot{z}_{e6}$	$\dot{z}_{e6}$	
19	$\dot{x}_I$	$x_I$	Inertial displacements of table c.g.
20	$\dot{y}_I$	$y_I$	
21	$\dot{z}_I$	$z_I$	
22	$\dot{\theta}$	$\theta$	Table Euler angles
23	$\dot{\psi}$	$\psi$	
24	$\dot{\phi}$	$\phi$	
25	$\dot{y}_{e1}$	$y_{e1}$	Bending deflections of actuators at top of cylinder
:	$\vdots$	$\vdots$	
30	$\dot{y}_{e6}$	$y_{e6}$	

## 3.2 (Continued)

<u>Index</u>	<u>Derivative</u>	<u>Variable</u>	<u>Variable Definition</u>
31	$\dot{z}_{e1}$	$z_{e1}$	Bending deflections of actuators at top of cylinder
$\vdots$	$\vdots$	$\vdots$	
36	$\dot{z}_{e6}$	$z_{e6}$	
37	$\dot{p}_{11}$	$p_{11}$	"Push" hydraulic pressure on actuator pistons
$\vdots$	$\vdots$	$\vdots$	
42	$\dot{p}_{16}$	$p_{16}$	
43	$\dot{p}_{21}$	$p_{21}$	"Pull" hydraulic pressure on actuator pistons
$\vdots$	$\vdots$	$\vdots$	
48	$\dot{p}_{26}$	$p_{26}$	
49	$\ddot{Q}_{o1}$	$\dot{Q}_{o1}$	Derivatives of no-load valve flow
$\downarrow$	$\downarrow$	$\downarrow$	
54	$\ddot{Q}_{o6}$	$\dot{Q}_{o6}$	
55	$\dot{Q}_{o1}$	$Q_{o1}$	No-load valve flow
$\downarrow$	$\downarrow$	$\downarrow$	
60	$\dot{Q}_{o6}$	$Q_{o6}$	
61	$\ddot{x}_{s1}$	$\dot{x}_{s1}$	Filtered actuator feedback velocities from second order filter
$\downarrow$	$\downarrow$	$\downarrow$	
66	$\ddot{x}_{s2}$	$\dot{x}_{s2}$	
67	$\dot{x}_{s1}$	$x_{s1}$	Filtered feedback displacements from second order filter
$\downarrow$	$\downarrow$	$\downarrow$	
72	$\dot{x}_{s6}$	$x_{s6}$	

## 3.2 (Continued)

<u>Index</u>	<u>Derivative</u>	<u>Variable</u>	<u>Variable Definition</u>
73 ↓	$\dot{a}_{01}$ ↓	$a_{01}$ ↓	Voltage output of first order lag filter in pressure feedback
78	$\dot{a}_{06}$	$a_{06}$	
79 ↓	$\dot{a}_{11}$ ↓	$a_{11}$ ↓	Voltage output of high pass filter in pressure feedback
84	$\dot{a}_{16}$	$a_{16}$	
85 ↓	$\dot{e}_1$ ↓	$e_1$ ↓	Voltage output of forward loop compensation filters
90	$\dot{e}_6$	$e_6$	

## 3.3 ERROR MESSAGES

- a. "THE INTEGRATION HAS FAILED AT T = XX.XXXX. ABORT AND GO TO NEXT CASE." - occurs if for some reason the integration procedure cannot continue. The program will abort the case and attempt to process another one.
- b. "ACTUATOR XXX HAS STROKED OUT...ABORT AND GO TO NEXT CASE." - occurs when an actuator has exceeded the maximum stroke. The program will abort the case and attempt to process another.
- c. "ERROR WHILE INVERTING MASS MATRIX...GO TO NEXT CASE." - is self-explanatory. The user should look for errors in input which may cause a singular or ill-conditioned mass matrix.
- d. There are also several error messages output by the integration routine. When one of these messages occurs, it is likely that an instability has occurred in the hydraulics or electronics caused by improper data.



#### 4.0 OPERATING INFORMATION

##### 4.1 PROGRAM AND DATA SETUP

The program may be input via standard EXEC II control cards on source or relocatable decks. All data for the program are input on cards.

##### 4.2 RUN INFORMATION

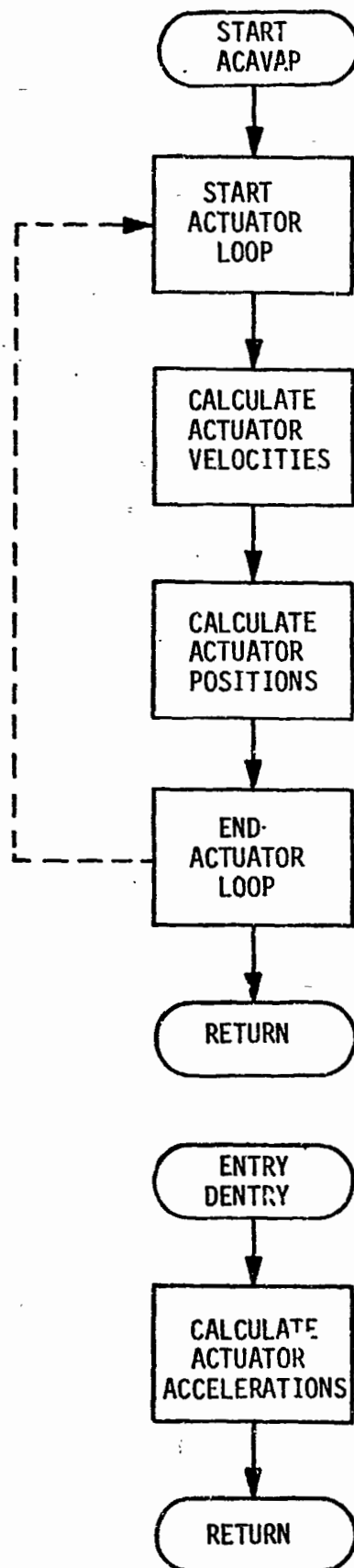
Compilation time for the program is about 40 seconds. Representative runs of about one second of simulation time have averaged approximately 8 minutes. Run time depends greatly upon the frequency of the hydraulics and electronics inputs.

#### 5.0 PROGRAMING INFORMATION

##### 5.1 FLOW CHARTS

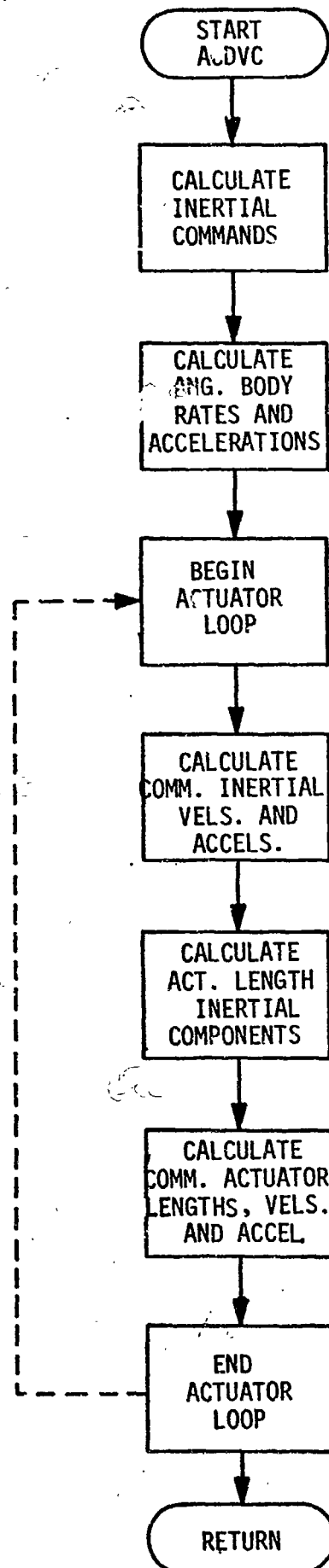
Program flow charts are shown on the following pages.

## ACAVAP: Actual Actuator Positions, Velocities, and Accelerations

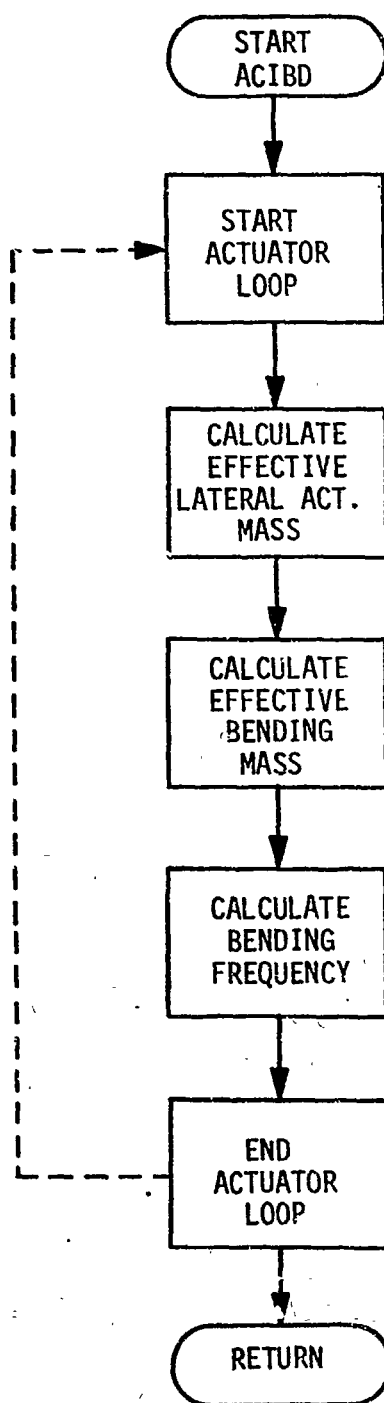


D2-118544-2

ACDVC: Actuator Displacement, Velocity, and Acceleration Commands

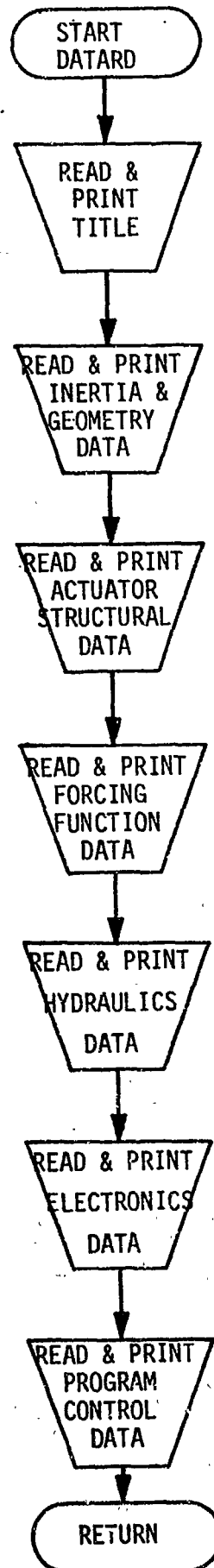


## ACIBD: Actuator Inertia and Bending Dynamics Parameters

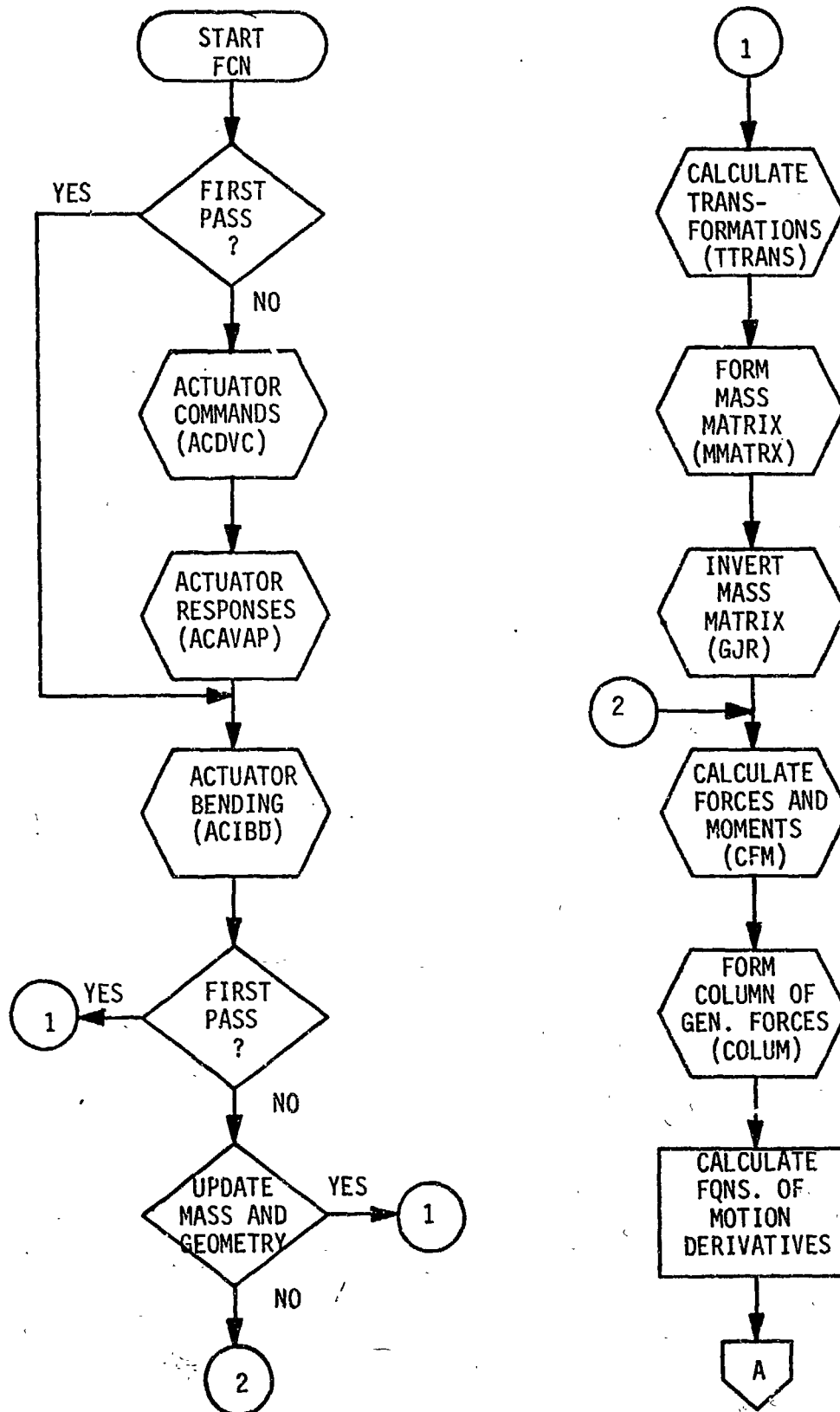


D2-118544-2

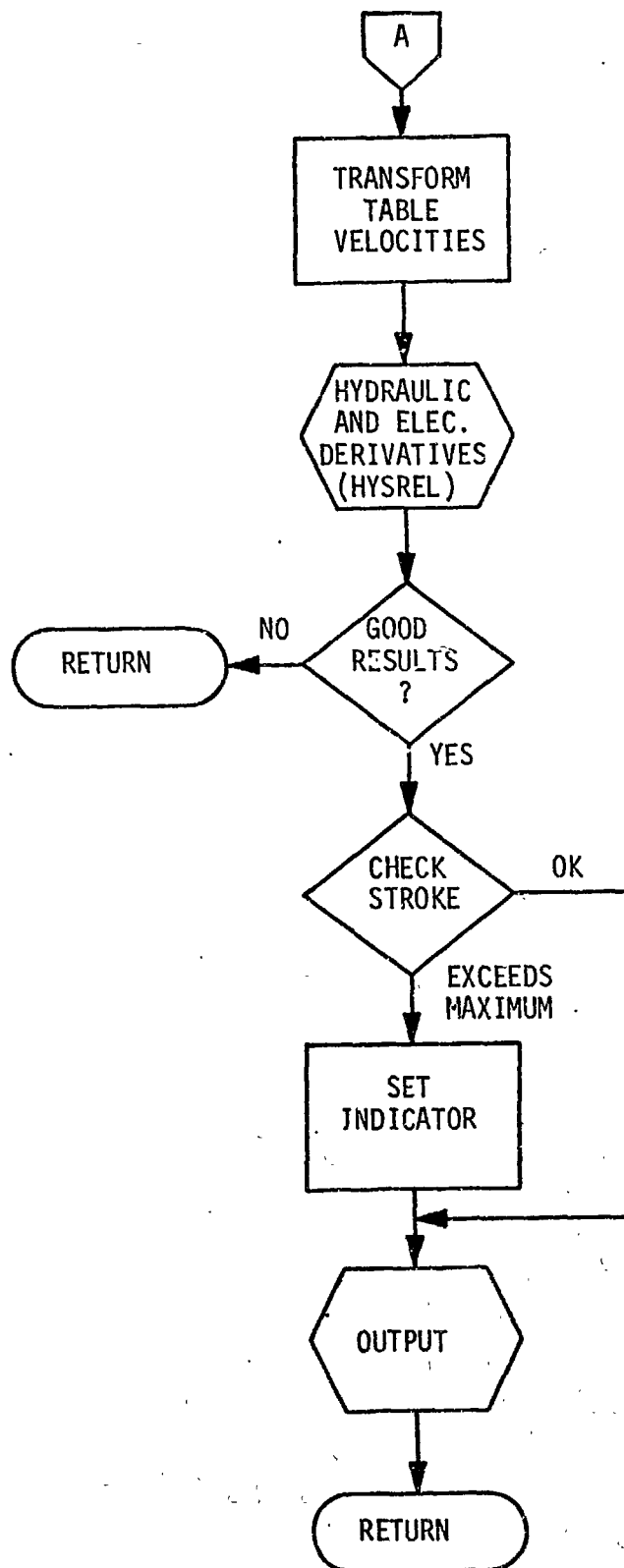
DATARD: Data Input Routine



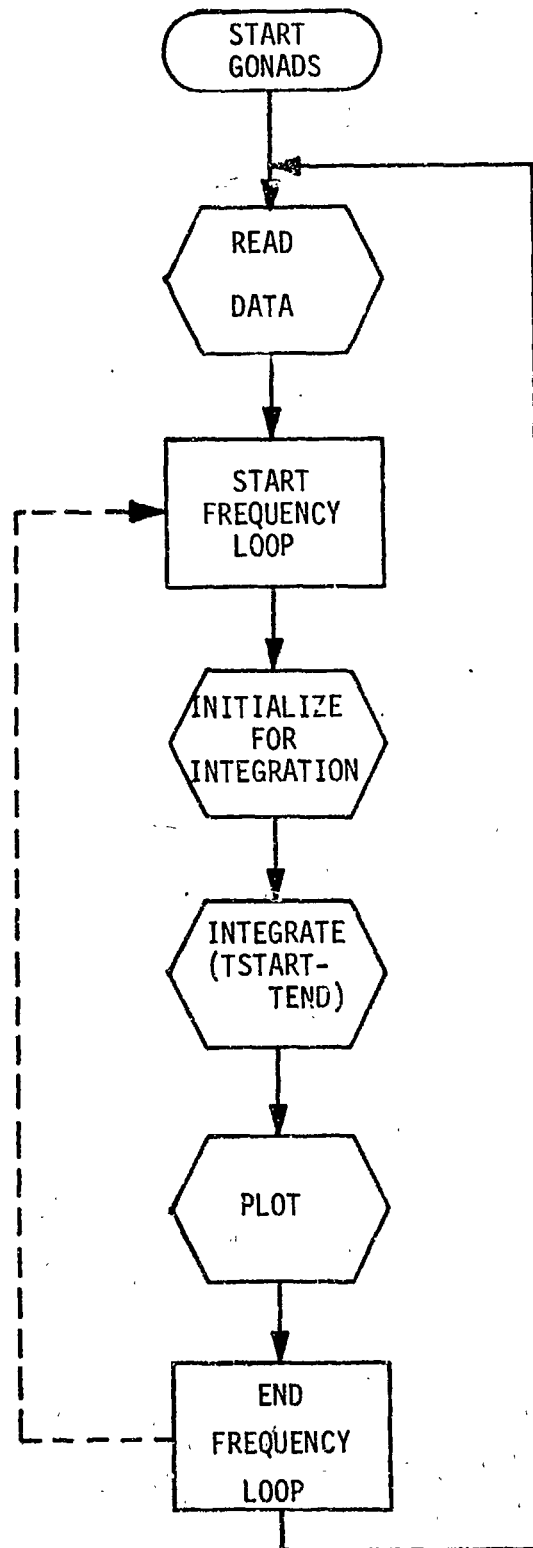
## FCN: Derivative Evaluation Control Routine



FCN (continued)

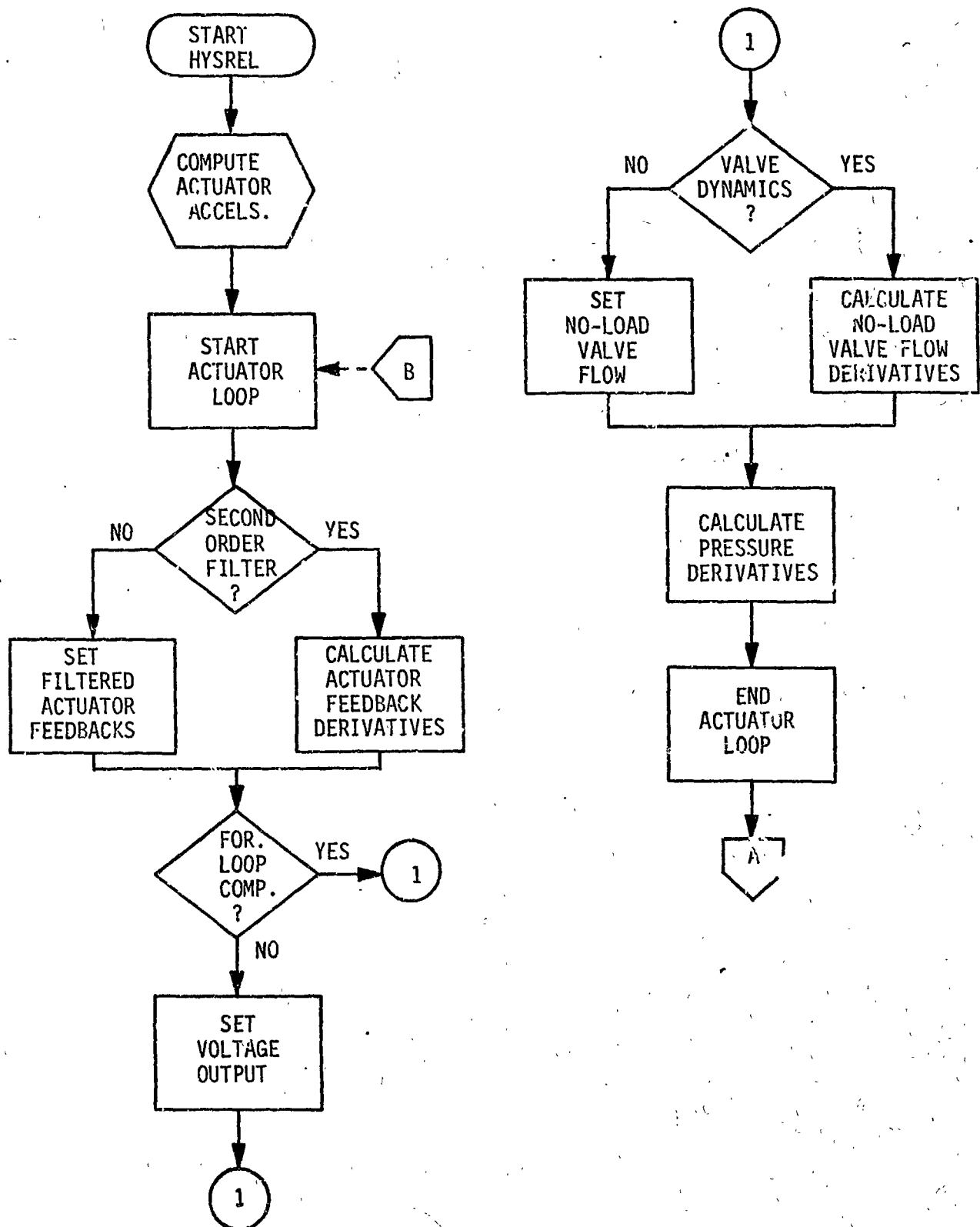


## GONADS: Main Control Routine

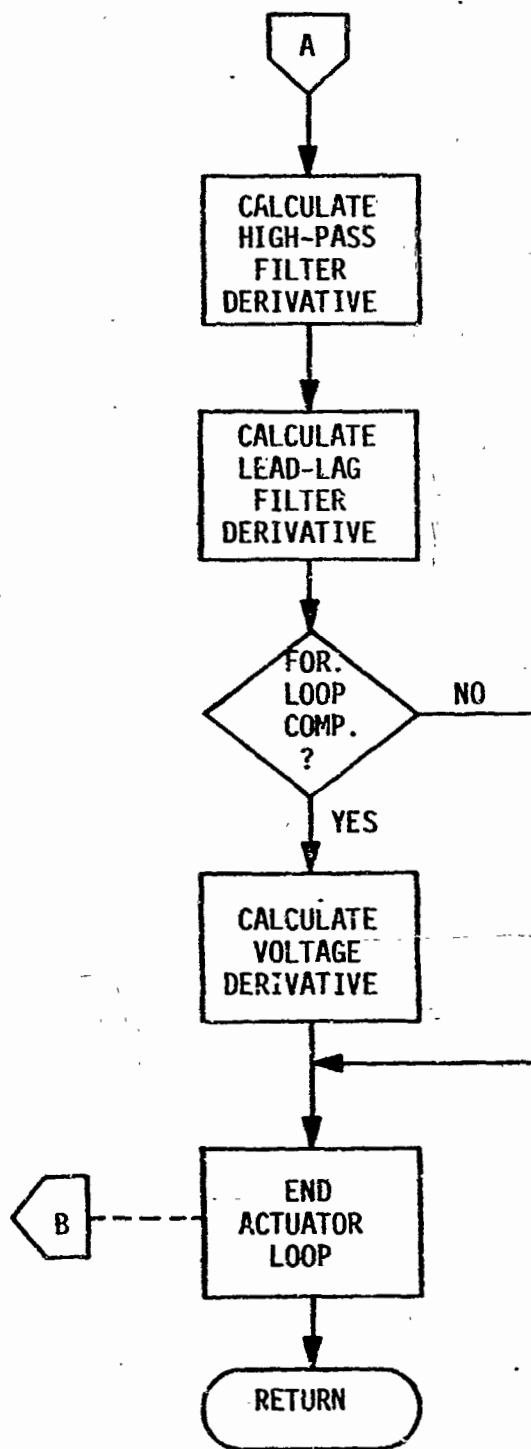




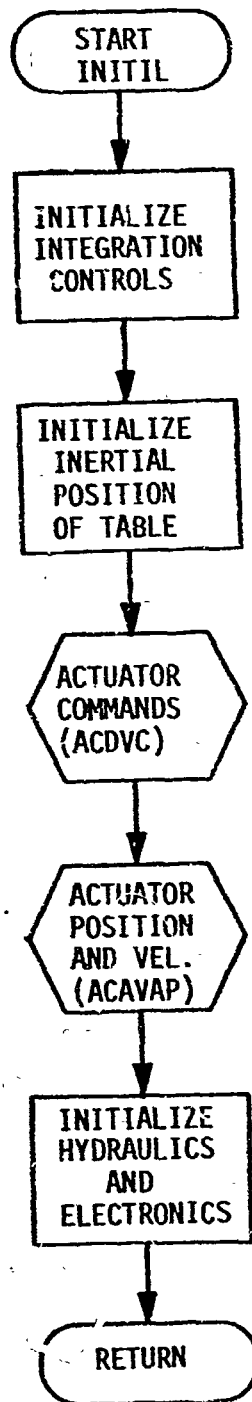
## HYSREL: Hydraulic and Servo Electronic Derivatives



## HYSREL (continued)

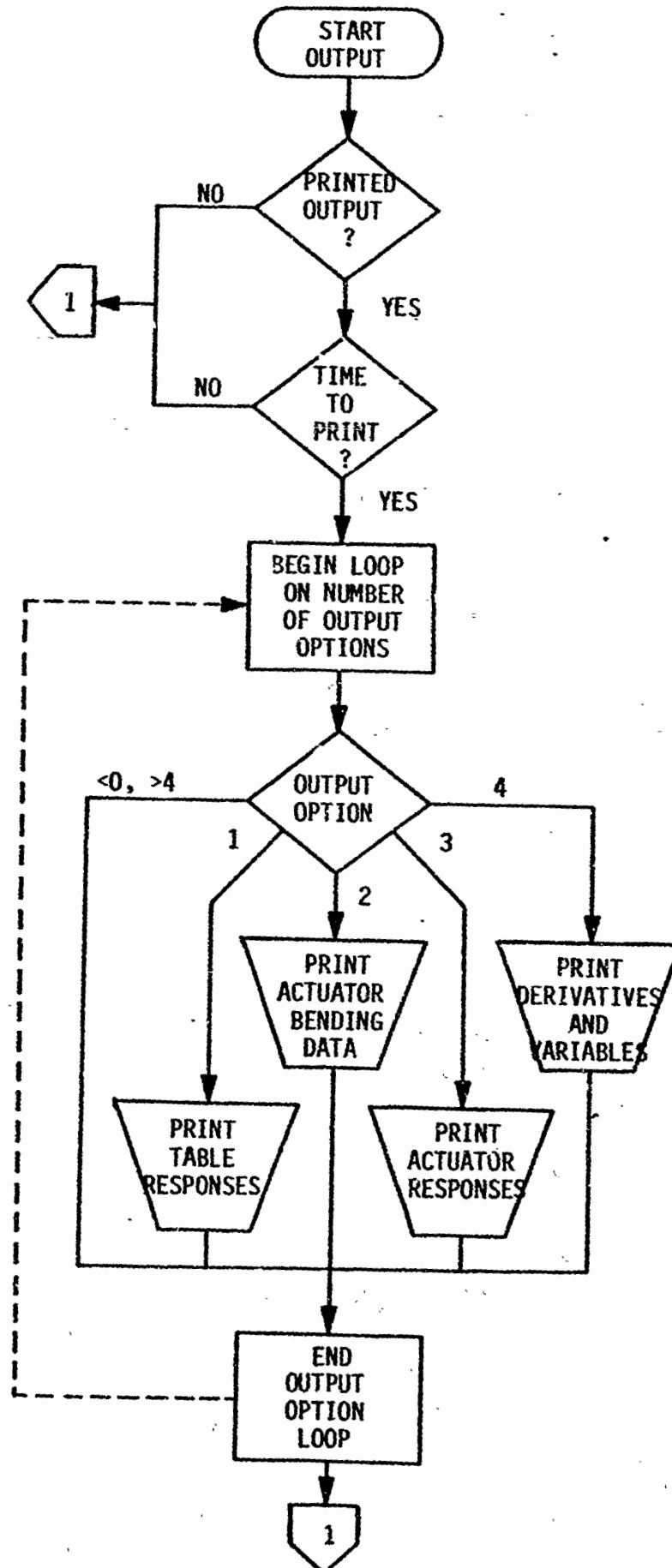


## INITIL: Initialization Routine

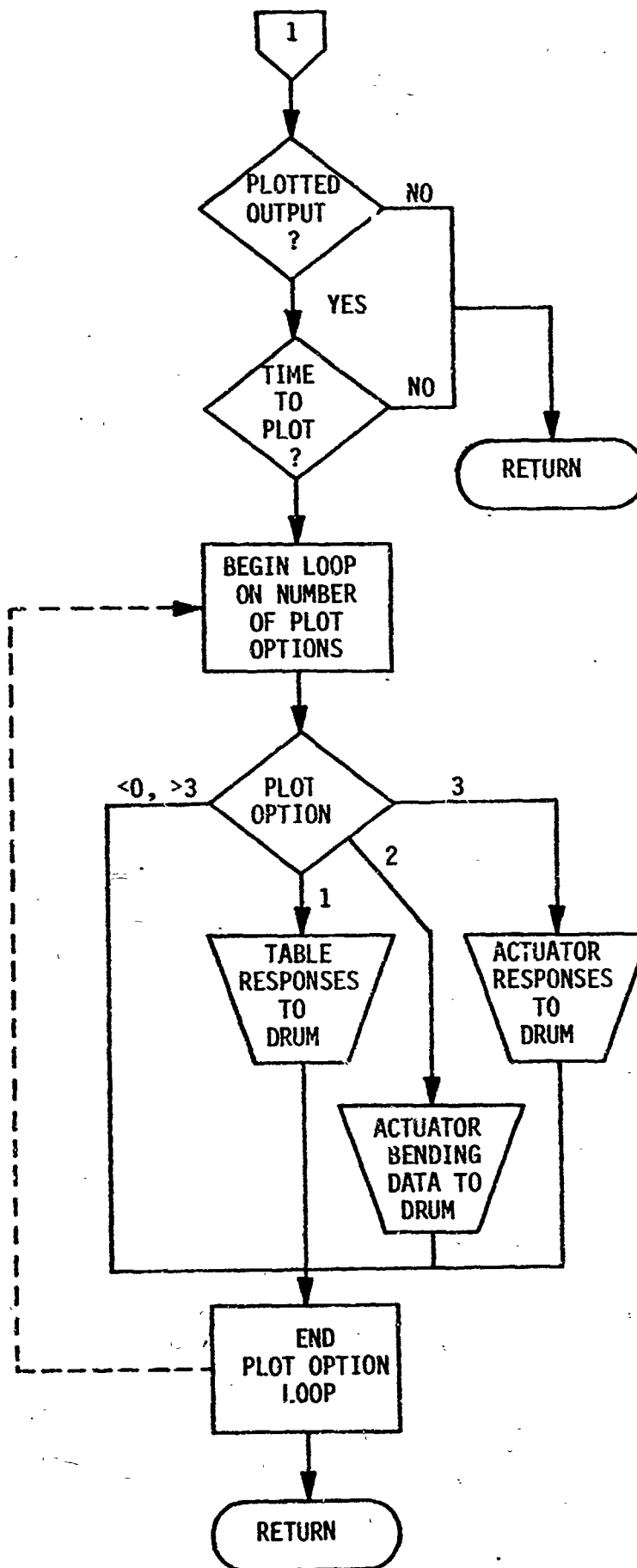


D2-118544-2

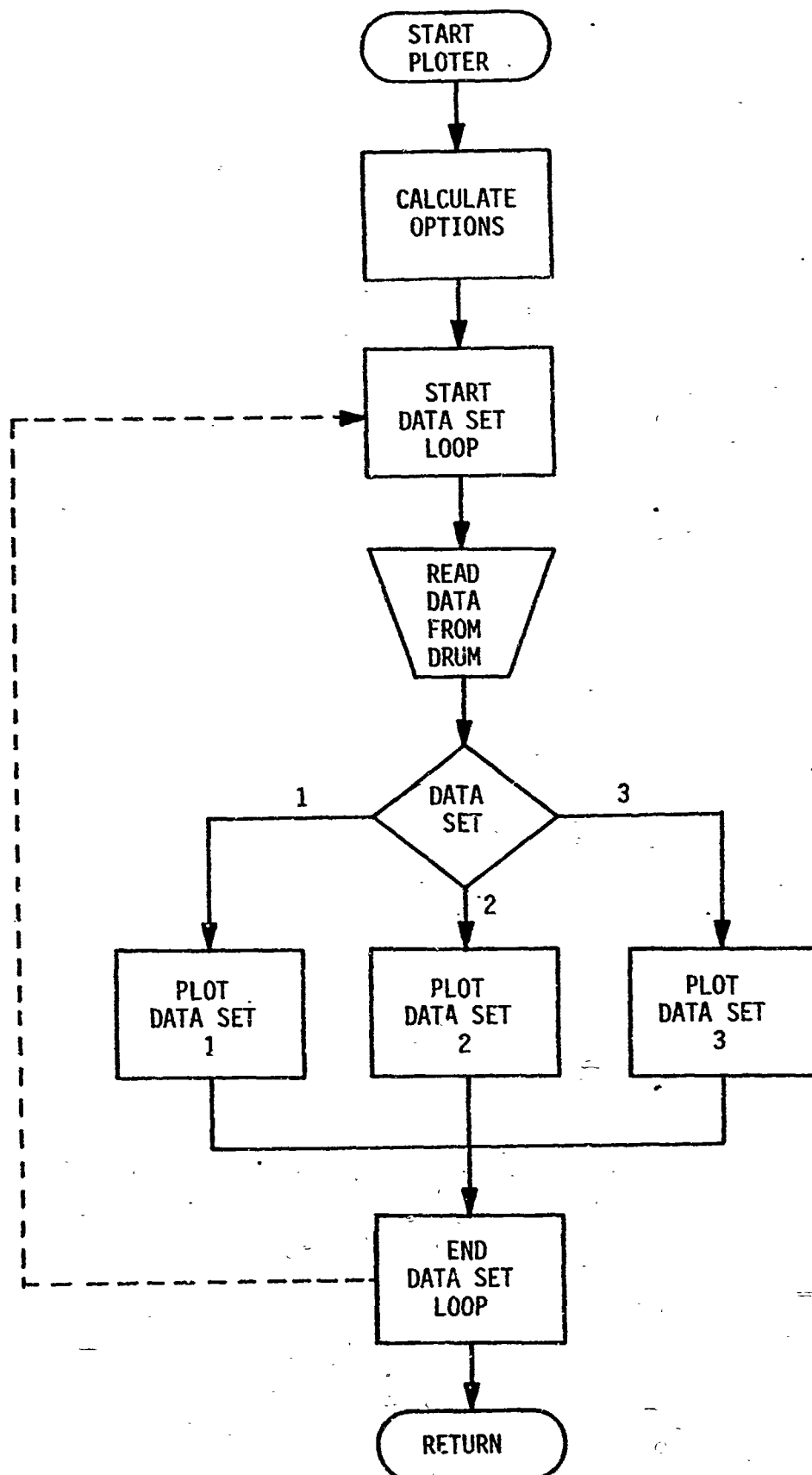
OUTPUT: Print and Write Output on Drum for Plots



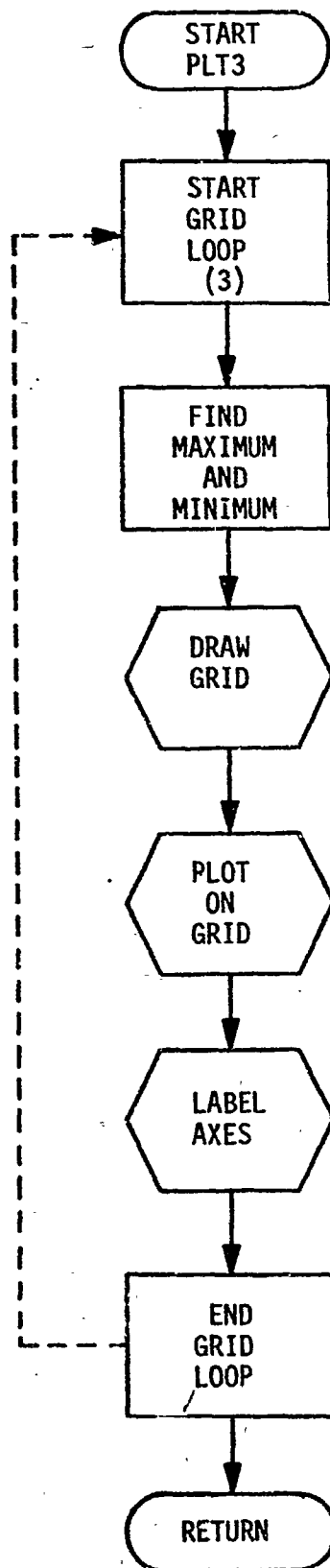
OUTPUT (continued)



## PLOTTER: Plot Control Routine



## PLT3: Routine to Form Three Plots per Frame



## 5.2 SYSTEM-STRUCTURE

No overlay structure is required for this program.

## 5.3 LIBRARY SUBROUTINES

Several routines from the Johnson Space Center plotting library are used. These routines and their functions are:

- FILMAV - advances the film
- GRDSET - sets line intensities
- GRID - forms a grid
- PLOTIV - plots an array of points
- PRINT - prints axis titles.

These routines may not be available at another location; in which case, the best action would likely be to substitute routines with the same functions rather than obtaining these routines from the JSC library.

## 5.4 PROGRAM LISTING

A complete program listing is shown on the following pages.





REPRODUCIBILITY OF THE  
ORIGINAL PAGE IS POOR

D2-118544-2

FCN	CODE	RELOCATABLE	28 JAN 74	23:27:18	1	01513042	72	1
INITIAL	SYMBOLIC		28 JAN 74	23:27:19	0	01513152	14	24
INITIAL	RELOCATABLE		28 JAN 74	23:27:19	0	01513672	14	43
FCN	SYMBOLIC		28 JAN 74	23:27:24	0	01515024	60	1
FCN	RELOCATABLE		28 JAN 74	23:27:24	0	01515120	14	16
ACDVC	SYMBOLIC		28 JAN 74	23:27:24	0	01515460	14	45
ACDVC	RELOCATABLE		28 JAN 74	23:27:24	0	01516446	40	1
ACDVC	SYMBOLIC		28 JAN 74	23:27:26	0	01517250	14	15
ACDVC	RELOCATABLE		28 JAN 74	23:27:26	0	01521534	48	86
DATARD	SYMBOLIC		31 JAN 74	21:52:34	0	01521614	14	31
DATARD	RELOCATABLE		31 JAN 74	21:52:34	0	01522476	14	156
			31 JAN 74	21:52:34	1	01526706	48	1
					0	01526766	14	102

ENTRY POINT TABLE

ACAVAP (ACAVAP/CODE)	1	000225	ACDVC (ACDVC/CODE)	1	000411	ACIAD (ACIAD/CODE)	1	000117
AMATRX (AMATRX/CODE)	1	000107	CFM (CFM/CODE)	1	000164	CHKOUT (CHKOUT/CODE)	1	000244
COLUM (COLUM/CODE)	1	000145	CROSS (CROSS/CODE)	1	000034	DATARD (DATARD/CODE)	1	001042
DENTRY (ACAVAP/CODE)	1	000230	FCN (FCN/CODE)	1	000254	GJR (GJR/CODE)	1	000616
MYSEL (MYSEL/CODE)	1	000302	INITIL (INITIL/CODE)	1	000116	MMATRX (MMATRX/CODE)	1	000437
M323 (M323/CODE)	1	000647	NRKVS (NRKVS/CODE)	1	001360	OUTPUT (OUTPUT/CODE)	1	000641
PLOTTER (PLOTTER/CODE)	1	000772	PL73 (PL73/CODE)	1	000163	RKINIT (RKINIT/CODE)	1	000033
YTRANS (YTRANS/CODE)	1	000127						

BLOCK TABLE EMPTY

COBOL LIBRARY TABLE EMPTY

PROCEDURE NAME TABLE EMPTY

3. TRI 8

5:35: 7.303

END CUR LCC 1102-039C L9

29 JUN 74 5:35: 7.423

8 FOR ACAPACAVAP  
UNIVAC 1108 FORTRAN V EXEC 11 LEVEL 25A - (EXEC) LEVEL E1201001041  
THIS COMPILATION WAS DONE ON 29 JUN 74 AT 05:35:107

SUBROUTINE ACAPAV ENTRY POINT 000225  
ENTRY POINT 000230

STORAGE USED: CODE(1) 000233; DATA(0) 000571; BLANK COMMON(2) 000009

COMMON BLOCKS:

0003 TRANS 000040  
0004 NRKVS1 000265  
0005 ACLVA 000044  
0006 INGEOD 000090

EXTERNAL REFERENCES (BLOCK, NAME)

0007 AMATRX  
0010 CROSS  
0011 SORT  
0012 NERR38

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000014 1326 0001 000032 1226 0001 000050 1326 0001 000132 1536  
0001 000142 1426 0000 R 000003 A 0005 R 000014 AA 0005 R 000006 AV  
0000 1 000026 I 0004 000001 INER 0000 000034 INJP8 0000 1 000027 J 0000 1 000025 L  
0000 000000 HT 0000 R 000017 RY2A 0000 R 000000 RAD 0000 R 000014 RAD5 0005 R 000022 RS  
0004 R 000007 RYA 0000 R 000010 RYZA 0003 R 000000 T 0004 000000 TIME 0000 R 000022 V  
0004 R 000001 A 0004 R 000133 XDOT 0006 R 000024 YZF

SUBROUTINE ACAPAV

ROUTINE TO COMPUTE THE ACTUAL ACTUATOR VELOCITIES, ACCELERATIONS,

AND POSITIONS

00101 10 COMMON / TRANS / (16,3,3)  
00101 20 COMMON / NRKVS1 / TIME, X(90), XDOT(50)  
00101 30 COMMON / ACLVA / AL(3), AV(3), AA(3), RS(3,6)  
00101 40 COMMON / INGEOD / MT, INER(6), RYA, RYZA(2,6), YZF(2,6)  
00101 50 DIMENSION RAD(3), AT(3,3), WADD(3), K(3), V(3)  
00101 60 CALL AMATRX(A)  
00101 70 RTT = RAA  
00101 80 DO 50 L=1,4  
00101 90 R(2) = RYZA(1,L)  
00101 100 R(3) = RYZA(2,L)  
00101 110 CALL CROSS(X(4),M,RAD)  
00101 120 AV(L) = 0.  
00101 130 DO 20 I=1,3  
00101 140 20 AV(L) = AV(L) + (X(I) \* RAD(I)) \* T(L,I,1)  
00101 150  
00101 160  
00101 170  
00101 180  
00101 190

```

00126 20* V(1) = 0.
00127 21* V(2) = YZF(1,1)
00130 22* V(3) = YZF(2,1)
00131 23* DO 40 I=1,3
00134 24* RS(I,1) = 0.
00135 25* DO 30 J=1,3
00140 26* 30 RS(I,1) = RS(I,1)+A(I,J)*R(J)
00142 27* 40 RS(I,1) = RS(I,1)+X(18,1)-V(I,1)
00144 28* AL(1) = SORT(RS(1,1)+2*RS(2,1)+2*RS(3,1)+2)
00145 29* 50 CONTINUE
00147 30* RETURN
00150 31* ENTRY DENTRY
00151 32* R(1) = RXA
00152 33* DO 60 L=1,4
00155 34* AA(L) = 0.
00156 35* R(2) = RYZA(1,1)
00157 36* R(3) = RYZA(2,1)
00160 37* CALL CROSS(XDOT(4),R,RADD)
00161 38* DO 60 I=1,3
00164 39* 60 AA(I) = AA(I)+XDOT(I)+RADD(I,1)+T(I,1,1)
00167 40* RETURN
00170 41* END

```

END OF COMPILATION: NO DIAGNOSTICS.

ACAVAP SYMBOLIC  
ACAVAP CODE RELOCATABLE

15 AUG 73 15:49:35 0 01443300 14 41 (DELETED)  
15 AUG 73 15:49:35 1 01443376 36 1 (DELETED)  
0 01444442 14 18

FOR: ACDCV,ACDCV  
UNIVAC 1108 FORTRAN V EXEC 11 LEVEL 25A -EXEC8 LEVEL #12010010A)  
THIS COMPILATION WAS DONE ON 29 JUN 74 AT 05135109

SUBROUTINE ACDVC ENTZY POINT 000411

```
STORAGE USED: CODE(1), 000430; DATA(0), 000105; BLANK COMMON(2), 000000
```

**COMMON BLOCKS:**

0003	FRFMD	000036
0004	NRKVS1	000265
0005	NTGRTO	000001
0006	INGEOD	000090
0007	ACDYAC	000047

**EXTERNAL REFERENCES (BLOCK, NAF**

0010	CROSS
0011	COS
0012	SIN
0013	SQR
0014	SQRT

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000005	1166	00001	000037	1266	0001	000179	1666	0001	000179	1756	0001	000221	2036
0001	003243	2126	0001	000247	2176	0001	000304	2336	0001	000307	2376	0001	000346	2516
0001	000017	301	0001	000054	501	0001	000054	501	0001	000014	724	0001	000000	741
0007	000000	CAY	0007	000035	CP	0000	000033	CS	0000	000031	CT	0003	000030	DL7A1
0005	000000	FRENCY	0000	000030	I	0004	000001	INER	0000	000056	NDPS	0000	000037	J
0000	000010	L	0006	000000	MT	0007	000004	OC	0000	000011	QCD	0003	000006	OMEGAC
0000	000001	R	0000	000025	RS	0000	000017	RSD	0000	000032	RSD	0006	000037	RXA
0006	000010	RY2A	0000	000036	SP	0000	000034	SS	0000	000032	ST	0000	000041	T
0007	000022	TOIC	0004	000030	TIME	0003	000000	TPO	0000	000031	TV	0000	000034	TVB
0004	000001	X	0004	000133	XOOT	0004	000034	YZF						

10001 10 SUBROUTINE ACQVC

```
0010: ROUTINE TO COMPUTE ACTUATOR DISPLACEMENT AND VELOCITY COMMANDS
```

00101  
00102  
00103  
00104  
00105  
00106  
00107  
00108  
00109  
00110  
00111  
00112  
00113  
00114  
00115  
00116  
00117  
00118  
00119  
00120  
00121  
00122  
00123  
00124  
00125  
00126  
00127  
00128  
00129  
00130  
00131  
00132  
00133  
00134  
00135  
00136  
00137  
00138  
00139  
00140  
00141  
00142  
00143  
00144  
00145  
00146  
00147  
00148  
00149  
00150  
00151  
00152  
00153  
00154  
00155  
00156  
00157  
00158  
00159  
00160  
00161  
00162  
00163  
00164  
00165  
00166  
00167  
00168  
00169  
00170  
00171  
00172  
00173  
00174  
00175  
00176  
00177  
00178  
00179  
00180  
00181  
00182  
00183  
00184  
00185  
00186  
00187  
00188  
00189  
00190  
00191  
00192  
00193  
00194  
00195  
00196  
00197  
00198  
00199  
00200  
00201  
00202  
00203  
00204  
00205  
00206  
00207  
00208  
00209  
00210  
00211  
00212  
00213  
00214  
00215  
00216  
00217  
00218  
00219  
00220  
00221  
00222  
00223  
00224  
00225  
00226  
00227  
00228  
00229  
00230  
00231  
00232  
00233  
00234  
00235  
00236  
00237  
00238  
00239  
00240  
00241  
00242  
00243  
00244  
00245  
00246  
00247  
00248  
00249  
00250  
00251  
00252  
00253  
00254  
00255  
00256  
00257  
00258  
00259  
00260  
00261  
00262  
00263  
00264  
00265  
00266  
00267  
00268  
00269  
00270  
00271  
00272  
00273  
00274  
00275  
00276  
00277  
00278  
00279  
00280  
00281  
00282  
00283  
00284  
00285  
00286  
00287  
00288  
00289  
00290  
00291  
00292  
00293  
00294  
00295  
00296  
00297  
00298  
00299  
00300  
00301  
00302  
00303  
00304  
00305  
00306  
00307  
00308  
00309  
00310  
00311  
00312  
00313  
00314  
00315  
00316  
00317  
00318  
00319  
00320  
00321  
00322  
00323  
00324  
00325  
00326  
00327  
00328  
00329  
00330  
00331  
00332  
00333  
00334  
00335  
00336  
00337  
00338  
00339  
00340  
00341  
00342  
00343  
00344  
00345  
00346  
00347  
00348  
00349  
00350  
00351  
00352  
00353  
00354  
00355  
00356  
00357  
00358  
00359  
00360  
00361  
00362  
00363  
00364  
00365  
00366  
00367  
00368  
00369  
00370  
00371  
00372  
00373  
00374  
00375  
00376  
00377  
00378  
00379  
00380  
00381  
00382  
00383  
00384  
00385  
00386  
00387  
00388  
00389  
00390  
00391  
00392  
00393  
00394  
00395  
00396  
00397  
00398  
00399  
00400  
00401  
00402  
00403  
00404  
00405  
00406  
00407  
00408  
00409  
00410  
00411  
00412  
00413  
00414  
00415  
00416  
00417  
00418  
00419  
00420  
00421  
00422  
00423  
00424  
00425  
00426  
00427  
00428  
00429  
00430  
00431  
00432  
00433  
00434  
00435  
00436  
00437  
00438  
00439  
00440  
00441  
00442  
00443  
00444  
00445  
00446  
00447  
00448  
00449  
00450  
00451  
00452  
00453  
00454  
00455  
00456  
00457  
00458  
00459  
00460  
00461  
00462  
00463  
00464  
00465  
00466  
00467  
00468  
00469  
00470  
00471  
00472  
00473  
00474  
00475  
00476  
00477  
00478  
00479  
00480  
00481  
00482  
00483  
00484  
00485  
00486  
00487  
00488  
00489  
00490  
00491  
00492  
00493  
00494  
00495  
00496  
00497  
00498  
00499  
00500  
00501  
00502  
00503  
00504  
00505  
00506  
00507  
00508  
00509  
00510  
00511  
00512  
00513  
00514  
00515  
00516  
00517  
00518  
00519  
00520  
00521  
00522  
00523  
00524  
00525  
00526  
00527  
00528  
00529  
00530  
00531  
00532  
00533  
00534  
00535  
00536  
00537  
00538  
00539  
00540  
00541  
00542  
00543  
00544  
00545  
00546  
00547  
00548  
00549  
00550  
00551  
00552  
00553  
00554  
00555  
00556  
00557  
00558  
00559  
00560  
00561  
00562  
00563  
00564  
00565  
00566  
00567  
00568  
00569  
00570  
00571  
00572  
00573  
00574  
00575  
00576  
00577  
00578  
00579  
00580  
00581  
00582  
00583  
00584  
00585  
00586  
00587  
00588  
00589  
00590  
00591  
00592  
00593  
00594  
00595  
00596  
00597  
00598  
00599  
00600  
00601  
00602  
00603  
00604  
00605  
00606  
00607  
00608  
00609  
00610  
00611  
00612  
00613  
00614  
00615  
00616  
00617  
00618  
00619  
00620  
00621  
00622  
00623  
00624  
00625  
00626  
00627  
00628  
00629  
00630  
00631  
00632  
00633  
00634  
00635  
00636  
00637  
00638  
00639  
00640  
00641  
00642  
00643  
00644  
00645  
00646  
00647  
00648  
00649  
00650  
00651  
00652  
00653  
00654  
00655  
00656  
00657  
00658  
00659  
00660  
00661  
00662  
00663  
00664  
00665  
00666  
00667  
00668  
00669  
00670  
00671  
00672  
00673  
00674  
00675  
00676  
00677  
00678  
00679  
00680  
00681  
00682  
00683  
00684  
00685

COMMON /NRKVS1/ TIME,X(90),XDOT(90)

[illegible]

COMMON / INGE00/ MY, INER(6), RXA, RYZA(2,6), YZF(2,6)

COMMON /ACDVAC/ CAL(6), CAV(6), CAV(8), CAV(10), CAV(12), CAV(14), CAV(16), CAV(18), CAV(20), CAV(22), CAV(24), CAV(26), CAV(28), CAV(30), CAV(32), CAV(34), CAV(36), CAV(38), CAV(40), CAV(42), CAV(44), CAV(46), CAV(48), CAV(50), CAV(52), CAV(54), CAV(56), CAV(58), CAV(60), CAV(62), CAV(64), CAV(66), CAV(68), CAV(70), CAV(72), CAV(74), CAV(76), CAV(78), CAV(80), CAV(82), CAV(84), CAV(86), CAV(88), CAV(90), CAV(92), CAV(94), CAV(96), CAV(98), CAV(100)	COMMON /ACDVAC/ CAL(6), CAV(6), CAV(8), CAV(10), CAV(12), CAV(14), CAV(16), CAV(18), CAV(20), CAV(22), CAV(24), CAV(26), CAV(28), CAV(30), CAV(32), CAV(34), CAV(36), CAV(38), CAV(40), CAV(42), CAV(44), CAV(46), CAV(48), CAV(50), CAV(52), CAV(54), CAV(56), CAV(58), CAV(60), CAV(62), CAV(64), CAV(66), CAV(68), CAV(70), CAV(72), CAV(74), CAV(76), CAV(78), CAV(80), CAV(82), CAV(84), CAV(86), CAV(88), CAV(90), CAV(92), CAV(94), CAV(96), CAV(98), CAV(100)	COMMON /ACDVAC/ CAL(6), CAV(6), CAV(8), CAV(10), CAV(12), CAV(14), CAV(16), CAV(18), CAV(20), CAV(22), CAV(24), CAV(26), CAV(28), CAV(30), CAV(32), CAV(34), CAV(36), CAV(38), CAV(40), CAV(42), CAV(44), CAV(46), CAV(48), CAV(50), CAV(52), CAV(54), CAV(56), CAV(58), CAV(60), CAV(62), CAV(64), CAV(66), CAV(68), CAV(70), CAV(72), CAV(74), CAV(76), CAV(78), CAV(80), CAV(82), CAV(84), CAV(86), CAV(88), CAV(90), CAV(92), CAV(94), CAV(96), CAV(98), CAV(100)
01100	01100	01100
00100	00100	00100
00000	00000	00000

0001	11	EQUIVALENCE (TV, I, F), (V, G, I, S)
------	----	--------------------------------------

Q0012	12°	DIMENSION R5D(3),R5D(3),RS(3)

TIME-DEPENDENT INERTIAL COMMANDS	C	C	C
00112	100		
00113	140		

2012 149 6

REPRODUCIBILITY OF THE  
ORIGINAL PAGE IS POOR

00113	150	IF(FRQCY	*GT*0.) GO TO 30	
00115	160	DO 20 I=1,4		
00120	170	TOIC(I) = T*O(I)*OALTA(I)*TIME		
00121	180	TOIC(I*2) = OALTA(I)		
00122	190	20 TOIC(I*12) = 0.		
00124	200	GO TO 50		
00125	210	30 DO 40 I=1,6		
00130	220	TOIC(I) = T*O(I)*OALTA(I)*SIN(FRQCY	*TIME)	
00131	230	TOIC(I*6) = FRQCY	*OALTA(I)*COS(FRQCY	*TIME)
00132	240	40 TOIC(I*12) = -FRQCY	*OALTA(I)*SIN(FRQCY	*TIME)
00134	250	50 CONTINUE		
00135	260	CT = COS(TOIC(4))		
00136	270	ST = SIN(TOIC(4))		
00137	280	CS = COS(TOIC(5))		
00140	290	SS = SIN(TOIC(5))		
00141	300	CP = COS(TOIC(6))		
00142	310	SP = SIN(TOIC(6))		
00143	320	AC(I,1) = CT*CS		
00144	330	AC(I,2) = -CT*CP*SS+ST*SP		
00145	340	AC(I,3) = SP*CT*SS*CP*ST		
00146	350	AC(2,1) = SS		
00147	360	AC(2,2) = CP*CS		
00150	370	AC(2,3) = -SP*CS		
00151	380	AC(3,1) = -ST*CS		
00152	390	AC(3,2) = CP*ST*SS*SP*CT		
00153	400	AC(3,3) = -SP*ST*SS*CP*CT		
00154	410	T(1,1) = SS		
00155	420	T(1,2) = 0.		
00156	430	T(1,3) = 1.		
00157	440	T(2,1) = CS*CP		
00160	450	T(2,2) = SP		
00161	460	T(2,3) = 0.		
00162	470	T(3,1) = -CS*ST		
00163	480	T(3,2) = CP		
00164	490	T(3,3) = 0.		
00165	500	DO 60 I=1,3		
00170	510	OC(I) = 0.		
00171	520	OC(1) = 0.		
00172	530	DO 60 J=1,3		
00175	540	OC(I) = OC(I)+T(I,J)*TOIC(J*9)		
00176	550	60 OC(1) = OC(1)+T(1,J)*TOIC(J*15)		
00201	560	R(1) = RAA		
00202	570	DO 120 I=1,4		
00205	580	R(2) = RYZA(I,1)		
00206	590	R(3) = RYZA(I,2)		
00207	600	CALL CROSS(OC,R,TV)		
00210	610	CALL CROSS(OC,R,TVD)		
00211	620	DO 80 I=1,3		
00214	630	RSO(I) = 0.		
00215	640	RSO(1) = 0.		
00216	650	DO 70 J=1,3		
00221	660	RSO(I) = RSO(I)+AC(I,J)*TV(J)		
00222	670	70 RSO(1) = RSO(1)+AC(1,J)*TV(J)		
00224	680	RSO(I) = RSO(I)+TOIC(I*6)		
00225	690	80 RSO(I) = RSO(I)+TOIC(I*12)		
00227	700	TV(I) = 0.		
00230	710	TV(2) = YZF(1,1)		
00231	720	TV(3) = YZF(2,1)		

REPRODUCTION OF THE  
ORIGINAL PAGE IS POOR

```

00232 730 DO 100 I=1,3
00235 740 RS(I) = 0.
00236 750 DO 90 J=1,3
00241 760 90 RS(I) = RS(I) + AC(I,J) * R(J)
00243 770 100 RS(I) = RS(I) + TO(I) * TV(I)
00245 780 CAL(I) = SQRT(RS(I) * 2 * RS(2) * 2 * RS(3) * 2)
00246 790 CAV(I) = 0.
00247 800 CAAL(I) = 0.
00250 810 DO 110 I=1,3
00253 820 CAV(I) = CAV(I) + RS(I) * RSD(I) / CAL(I)
00254 830 110 CAAL(I) = CAAL(I) + RS(I) * RSD(I) / CAL(I)
00256 840 120 CONTINUE
00260 850 RETURN
00261 860 END

```

END OF COMPILATION: NO DIAGNOSTICS.

ACBVC SYMBOLIC

ACBVC CODE RELOCATAB 2

28 JAN 74 23:27:26 0 0157250 14 94 (DELETED)  
 28 JAN 74 23:27:26 1 01571534 48 1 (DELETED)  
 0 01521614 14 31

FOR AC180, AC180  
UNIVAC 1108 FORTRAN V EXEC 11 L VEL 28A -EXEC8 LEVEL 212010010A1  
THIS COMPILATION WAS DONE ON 29 JUN 74 AT 05135111

29 JUN 74

S136110-988

SUBROUTINE A-180 ENTRY POINT 000117

STORAGE USED: CODE(1) 0001261 DATA(0), 0000361 BLANK COMMON(2) 000000

COMMON BLOCKS:

0003 AC180 00010  
0004 AC180 00006  
0005 AC180 00002

EXTERNAL REFERENCES (BLOCK NAME)

0004 S287  
0007 MERRIS

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000032 I113 0004 R 000000 AL 0000 R 000000 C 0003 R 000004 ER 0003 R 000002 IAC  
0000 000013 INJPS 0000 R 000000 LP 0000 I 000007 LC 0003 R 000007 CPA  
0003 R 000004 LR 0003 000005 LO 0005 R 000004 ML 0003 R 000001 MP 0003 R 000000 MO  
0005 R 000014 OMEGAE 0000 R 000002 PL 0000 R 000005 RL 0003 R 000000 ZETA

SUBROUTINE AC180

ROUTINE TO COMPUTE THE ACTUATOR INERTIA AND SENDING DYNAMICS

PARAMETERS

00101 10 C  
00101 20 C  
00101 30 C  
00101 40 C  
00101 50 C  
00103 60 REAL LR, LC, TAC, MP, ML, PL  
00104 70 COMMON /ACTRD/ ZETA, MP, TAC, LC, LR, LG, ER, LP  
00105 80 COMMON /AC180/ AL, RL  
00106 90 COMMON /ACTND/ MO(6), ML(4), OMEGAE(6)  
00107 100 LP = MP \* LG \* 27/12  
00110 110 DO 20 L=1,6  
00113 120 PL = AL(L) \* LR  
00115 130 RL = AL(L) \* LC  
00115 140 RL2 = LR \* PL  
00116 150 ML(1) = (TAC \* LP \* MP \* PL \* LR / 21000) / AL(1) \* 1000  
00117 160 MO(1) = TAC \* LG \* 27 / 12  
00120 170 C = 3 \* (MO(1) \* RL \* C \* PL \* PL) \* (LR \* PL) \* (LC \* PL)  
00120 180 I = 7 \* (LR \* RL \* C \* 27 / 12)  
00121 190 OMEGAE(L) = SQRT(C / MO(L))  
00122 200 DO CONTINUE  
00124 210 RETURN  
00126 220 END

END OF COMPILATION NO DIAGNOSTICS



ACID	CODE	SYMBOLIC	RELOCATABLE	15 AUG 73	15149137	0	0148036	34	22	(DELETED)
ACID	CODE	SYMBOLIC	RELOCATABLE	15 AUG 73	15149137	1	0148822	36	1	(DELETED)
						0	0148866	14	11	

FOR ANATX:ANATX  
UNIVAC-1100 FORTRAN V EXEC 11 LEVEL 254 - EXEC LEVEL 112010010A1  
THIS COMPILATION WAS DONE ON 29 JUN 74 AT 05135112 8:35:12.37

SUBROUTINE ANATX ENTRY POINT 000107

STORAGE USED: CODE(1) 000111 DATA(0) 000211 BLANK COMMON(2) 000000

COMMON BLOCKS:

0003 HRRVSI 000133

EXTERNAL REFERENCES (BLOCK NAME)

0004 C2S  
0005 SIN  
0006 HERR3S

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000 R 000001 CP 0000 R 000002 CS 0000 R 000000 CT 0000 R 000005 SP  
0000 R 000003 SS 0000 R 000001 ST 0003 R 000001 X

00101 10 SUBROUTINE ANATX(ATA)  
00103 20 DIMENSION A(3,3)  
00104 30 COMMON /HRRVSI/ Y,X(90)  
00105 40 CT = COS(X(22))  
00106 50 ST = SIN(X(22))  
00107 60 CS = COS(X(23))  
00108 70 SS = SIN(X(23))  
00109 80 CP = COS(X(24))  
00110 90 SP = SIN(X(24))  
00111 100 A(1,1) = CT\*CS  
00112 110 A(1,2) = -CT\*SS+ST\*CP  
00113 120 A(1,3) = SP\*CT+SS\*CP\*ST  
00114 130 A(2,1) = SS  
00115 140 A(2,2) = CP\*CS  
00116 150 A(2,3) = -SP\*CS  
00117 160 A(3,1) = -ST\*CS  
00118 170 A(3,2) = CP\*SS+ST\*CP\*CT  
00119 180 A(3,3) = -SP\*ST+SS\*CP\*CT  
00120 190 RETURN  
00121 200 END

END OF COMPILATION: NO DIAGNOSTICS.

ANATX SYMBOLIC  
ANATX CODE RELOCATABLE

15 AUG 73 18199129 0 0141550 14 20 (DELETED)  
16 AUG 73 18199129 1 C142200 24 1 (DELETED)  
0 0142200 14 9

5738113.751

29 JUN 74

FOR CPM, CPM  
UNIVAC 1108 FORTRAN V EXEC 11 LEVEL 251 -EXECED LEVEL E12010010A1  
THIS COMPILATION WAS DONE ON 29 JUN 74 AT 08135113

SUBROUTINE CPM ENTRY POINT 000164

STORAGE USED: CODE(11) 0001741 DATA(0) 0000381 BLANK COMMON(2) 000000

COMMON BLOCKS:

0003 ACLVA 000014  
0004 FORCES 000014  
0005 TRANS 000046  
0006 INGEOD 000024  
0007 HYDRO 000031  
0010 MKXVS1 000245  
0011 PRCFND 000050  
0012 HYGRD 000002

EXTERNAL REFERENCES (BLOCK, NAME)

0013 CROSS  
0014 SIN  
0015 HERN33

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000011 1210 0001 000051 1320 0001 000073 151 0001 000075 1506 0001 000114 1576  
0001 000122 1640 0001 000134 1720 0007 R 000001 A 0007 000000 AL 0003 R 000006 AV  
0007 000013 BETAE 0007 R 000023 BP 0000 R 000013 CP 0007 000005 CP 0012 R 000001 EXPRQ  
0007 R 000015 FF 0004 R 000000 FH 0011 000000 FILL 0011 R 000042 FHEXT 0004 R 000004 FP  
0012 000000 FRBNCY 0000 I 000012 I 0004 000001 INER 0000 000021 INJPS 0011 000040 IAT  
0001 000014 J 0007 000014 KC 0004 R 000003 MH 0006 000000 HT 0001 000041 NTFREQ  
0007 000000 PS 0010 R 000045 PI 0010 R 000053 P2 0000 R 000000 R 0004 R 000007 RXA  
0006 R 000010 RYZA 0006 R 000000 T 0010 R 000000 TIME 0000 R 000003 V 0000 R 000007 VSM  
0007 000003 VO 0000 R 000006 VI 0010 000001 X 0010 000133 X00Y

SUBROUTINE CPM

ROUTINE TO COMPUTE FORCES AND MOMENTS FOR THE EQUATIONS OF MOTION

00101 10 C  
00101 20 C  
00101 30 C  
00101 40 C  
00103 50 REAL\*8  
00104 60 COMMON /ACLVA / AL(6),AV(6)  
00105 70 COMMON /FORCES/ FHT3,HT33,PT67  
00106 80 COMMON /TRANS/ T(4,3,3)  
00107 90 COMMON /TNGVD07/ MT,INER(6),TX,MY,ZAT2(6)  
00110 100 COMMON /HYDRO / PS,AL2,VOL2,CP(6),BETAE,KC,FF(6),BP(6)  
00111 110 COMMON /MKXVS1/ TIME,T(90),XDOTT(90)  
00112 120 COMMON /PRCFND/ FILL(32),IXP,NTFREQ,FHEXT(6)  
00113 130 COMMON /HYGRD/ PRONGY,EXPRQ  
00114 140 DIMENSION PL(6),P2(6), R(3),V(3),V(3)

REPRODUCIBILITY OF THE  
ORIGINAL PAGE/IS POOR

```

00118 150 EQUIVALENCE (PI,X(37)),(P2,X(43))
00119 140 DATA VBW/0.05/
00120 170 DO 10 I=1,6
00121 180 CF = 1.0
00122 190 CF = SIGN(CF,AV(1))
00123 200 IF (ABS(AV(1))>1.0) VBW = CF*AV(1)/VBW
00124 210 10 FM(1) = A(1)*PI(1)-A(2)*P2(1)*DP(1)*AV(1)*CF*PI(1)
00125 220 DO 20 I=1,3
00126 230 FM(I) = 0.0
00127 240 MH(1) = 0.0
00128 250 IF (I*PI*EQ,0) GO TO 15
00129 260 FM(1) = FMEXT(1)
00130 270 MH(1) = FMEXT(1)
00131 280 IF (I*PI*EQ,1) GO TO 15
00132 290 FM(1) = FMEXT(1)*SIN(PI*PQ*TIME)
00133 300 MH(1) = FMEXT(1)*SIN(PI*PQ*TIME)
00134 310 15 CONTINUE
00135 320 DO 20 J=1,6
00136 330 20 FM(J) = FM(1)*PI(J)*PI(J)
00137 340 R(1) = RXA
00138 350 DO 50 I=1,6
00139 360 R(2) = RYZA(1,1)
00140 370 R(3) = RYZA(2,1)
00141 380 DO 30 J=1,3
00142 390 V(J) = Y(1,1)*J
00143 400 CALL CROSS(R,V,V1)
00144 410 DO 40 J=1,3
00145 420 MH(J) = MH(1)*PI(J)*PI(J)
00146 430 50 CONTINUE
00147 440 RETURN
00148 450 END

```

END OF COMPILATION: NO DIAGNOSTICS.

CPN	CODE	SYMBOLIC	RELOCATABLE
28 JAN 74	23127124	0	01515460
28 JAN 74	23127124	1	01516496
		0	01516726

CPN	CODE	SYMBOLIC	RELOCATABLE
28 JAN 74	23127124	14	48 (DELETED)
28 JAN 74	23127124	48	1 (DELETED)
		14	15

REPRODUCIBILITY OF THE  
ORIGINAL PAGE IS POOR

29 JUN 74 5:35:15.168

W FORS CHECKOUT/CHKOUT  
UNIVAC 1108 FORTRAN V EXEC 11 LEVEL 254 - (EXECB LEVEL) E12010010A)  
THIS COMPILE/TON WAS DONE ON 29 JUN 74 AT 05135115

SUBROUTINE CHKOUT ENTRY POINT 000254

STORAGE USED: CODE(11) 0002541 DATA(0) 0001211 BLANK COMMON(2) 000000

COMMON BLOCKS:

0003 EGMC 000022  
0004 MASS 000504  
0005 FORCES 000014  
0006 NRKVS1 000265  
0007 ACQVAC 000022  
0010 ACLVA 000022  
0011 ACTEND 000022  
0012 TRANS 000066

EXTERNAL REFERENCES (BLOCK, NAME)

0013 MNDUS  
0014 N1028  
0015 N1015  
0016 N1015

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000014 1226 0001 000026 1326 0001 000040 1416 0001 000048 1456  
0001 000052 1516 0001 000044 1406 0001 000074 1706 0001 000111 1776  
0001 000115 2026 0001 000116 2046 0001 000142 2176 0001 000160 2276  
0001 000145 2336 0001 000177 2426 0001 000231 2606 0000 000003 901F  
0000 000007 902F 0000 000020 903F 0000 000031 904F 0000 000052 906F  
0000 000056 907F 0000 000064 908F 0000 000070 910F 0000 000074 911F 0010 R 000014 AA  
0010 R 000000 AL 0010 R 000006 AV 0007 R 000014 CAA 0007 R 000003 CAL  
0007 R 000004 CAV 0005 R 000000 FMHD 0005 R 000006 FP 0001 R 000000 I 0000 000104 INJPS  
0000 I 000001 J 0000 I 000002 K 0004 R 000000 M 0011 R 000000 MQ  
0011 R 000014 ONEGAE 0012 R 000000 T 0006 R 000000 TIME 0004 R 000001 X 0006 R 000133 XDOT

SUBROUTINE CHKOUT

00101 1F  
00103 20  
00104 30  
00105 40  
00106 50  
00107 60  
00110 70  
00111 80  
00112 90  
00113 100  
00114 110  
00117 120

REAL M-HO,ML  
COMMON / EGMC / C(18)  
COMMON / MASS / M(18,18)  
COMMON / FORCES / FND(61,PP(6))  
COMMON / NRKVS1 / TIME,RI(90),XDOT(190)  
COMMON / ACQVAC / CAL(67),CAV(67),CA(67)  
COMMON / ACLVA / AL(6),AV(6),AA(6)  
COMMON / ACTEND / NG(67),ML(67),ONEGAE(6)  
COMMON / TRANS / T(6,3,3)  
WRITE(6,101) TIME  
901 FORMAT(1//,5X:TIME,111.5)

```

00120 130 WRITE(6,902) CAL,CAV,CAA
00136 150 902 FORMAT(5X,AL,6G15.5/ 5X,CAV,6G15.5/ 5X,CAA,6G15.5)
00137 150 WRITE(6,903) AL,CAV,AA
00155 160 903 FORMAT(5X,AL,6G15.5/ 5X,CAV,6G15.5/ 5X,AA,6G15.5)
00156 170 WRITE(6,904) HQ,HL,ONEGAE
00174 180 904 FORMAT(5X,HQ,6G15.5/ 5X,HL,6G15.5/ 5X,ONEGAE,6G15.5)
00175 190 WRITE(6,905) J1,J2,J3,J4,J5,J6,J7,J8,J9,J10,J11,J12,J13,J14,J15,J16
00182 200 905 FORMAT(5X,J1,12G15.5/ 5X,J2,12G15.5/ 5X,J3,12G15.5/ 5X,J4,12G15.5/ 5X,J5,12G15.5/ 5X,J6,12G15.5/ 5X,J7,12G15.5/ 5X,J8,12G15.5/ 5X,J9,12G15.5/ 5X,J10,12G15.5/ 5X,J11,12G15.5/ 5X,J12,12G15.5/ 5X,J13,12G15.5/ 5X,J14,12G15.5/ 5X,J15,12G15.5/ 5X,J16,12G15.5)
00213 210 906 FORMAT(5X,MASS,12G15.5)
00224 220 906 FORMAT(5X,MASS,12G15.5)
00225 230 WRITE(6,907) FMHO,EP
00237 240 907 FORMAT(5X,FMHO,6G15.5/ 5X,EP,6G15.5)
00240 250 WRITE(6,908) C
00246 260 908 FORMAT(5X,C,12G15.5)
00247 270 WRITE(6,910) X
00255 280 910 FORMAT(5X,X,12G15.5)
00256 290 WRITE(6,911) XOOT
00264 300 911 FORMAT(5X,XOOT,12G15.5)
00265 310 RETURN
00266 320 END

```

END OF COMPILATION! NO DIAGNOSTICS.

CHKOUT SYMBOLIC  
CHKOUT CODE RELOCATABLE

```

15 AUG 73 15:09:26 0 01936670 14 32 (DELETED)
15 AUG 73 15:09:26 1 01937570 60 1 (DELETED)
0 01937644 14 26

```

535:16.17

29 JUN 74

B FOR\* COLUMN,COLUN  
UNIVAC 1108 FORTRAN V EXEC 11 LEVEL 25A - (EXEC8 LEVEL E12010010A1)  
THIS COMPILATION WAS DONE ON 29 JUN 74 AT 05135116

SUBROUTINE COLUM ENTRY POINT 000155

STORAGE USED: CODE(1) 0001611 DAY(10) 0000471 BLANK COMMON(2) 0000000

COMMON BLOCKS:

0003 INGE00 000007  
0004 ACSTR0 000001  
0005 NRKVS1 000265  
0006 FORCES 000006  
0007 ACTBND 000022  
0010 EQMC 000022

EXTERNAL REFERENCES (BLOCK, NAME)

0011 CROSS  
0012 NERR38

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000007 1156 0001 000037 1336 0001 000042 1376 0001 000067 1466 0001 000075 1536  
0010 R 000000 C 0004 R 000000 PM 0000 I 000014 I 0000 R 000000 IMATRX 0003 R 000001 INER  
0000 000023 INJPS 0000 I 000015 J 0000 I 000016 K 0007 000006 ML 0007 R 000000 M0  
0002 R 000000 MT 0007 R 000014 OMEGA 0000 R 000011 Q 0005 000000 T 0005 R 000001 X  
0005 000133 XDOT 0004 R 000000 ZETA

ROUTINE TO CALCULATE THE EQUATIONS OF MOTION COLUMN

00100 10 C  
00108 20 C  
00100 30 C  
00101 40 SUBROUTINE COLUM  
00103 50 REAL IMATRX(3,3), INER, M0, MT  
00104 60 DIMENSION Q(3)  
00105 70 COMMON / INGE00 / MT, INER(4)  
00106 80 COMMON / ACSTR0 / ZETA

00107 90 COMMON / NRKVS1 / T, X(90), XDOT(90)  
00110 100 COMMON / FORCES / F(6)  
00111 110 COMMON / ACTBND / M(6), ML(4), OMEGA(4)  
00112 120 COMMON / EQMC / C(18)  
00112 130 C  
00112 140 C  
00112 150 C  
00113 160 CALL CROSSIE(4), X, C1  
00114 170 DO 20 I=1,3  
00117 180 Z0 = 0  
00117 190 Z0 = 0  
00117 200 C  
00117 210 C

END OF COMPILATION:		NO DIAGNOSTICS:
COLUMN	SYMBOLIC	
COLUMN	CODE	RELOCATABLE

	14	46 (DELETED)
16 AUG 73 13:39112	0	0142060
16 AUG 73 13:39112	0	0142244
16 AUG 73 13:39112	0	0142344



29 JUN 74 5105118.2

6 FOR: CROSS, CROSS  
 UNIVAC 1108 FORTRAN V EXEC 11 LEVEL 25A - (EXEC8 LEVEL E12010010A)  
 THIS COMPILATION WAS DONE ON 29 JUN 74 AT 05135118

SUBROUTINE CROSS ENTRY POINT 000036

STORAGE USED: CODE(1) 000043; DATA(0) 000010; BLANK COMMON(2) 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NEAR35

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000 000000 IN/PS

```

00101 10 SUBROUTINE CROSS(V1,V2,R)
00103 20 DIMENSION V1(1),V2(1),R(1)
00104 30 R(1) = V1(2)+V2(3)-V1(3)+V2(2)
00105 40 R(2) = V1(3)+V2(1)-V1(1)+V2(3)
00106 50 R(3) = V1(1)+V2(2)-V1(2)+V2(1)
00107 60 RETURN
00110 70 END

```

END OF COMPILATION: NO DIAGNOSTICS.

CROSS SYMBOLIC

CODE RELOCATABLE

15 AUG 73	15149132	0	01443014	14	7	(DELETED)
15 AUG 73	15149132	1	01443140	24	1	(DELETED)
		0	01443210	34	4	

REPRODUCIBILITY OF THE  
ORIGINAL PAGE IS POOR

59 JUN 74 513519.12

FOR: DATARD.DATARD  
UNIVAC 1100 FORTRAN V EXEC 11 LEVEL 25A -EXECER LEVEL EL2010010A1  
THIS COMPILATION WAS DONE ON 29 JUN 74 AT 05135119

SUBROUTINE DATARD ENTRY POINT 0010047

STORAGE USED: CODE(1) 0010551 DATA(0) 0007601 BLANK COMMON(2) 000000

# COMMON BLOCKS:

0003 INGE00 000040  
0004 ACSTRD 000010  
0005 PRCFND 000072  
0006 HYDR0 000031  
0007 ELECO 000044  
0010 HYERIC 000006

# EXTERNAL REFERENCES (BLOCK, NAME)

0011 MROUS  
0012 MIOIS  
0013 MIOGS  
0014 MROUS  
0015 NSTO'S  
0016 MERRIS

# STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0003	001032	100L	0001	000007	153G	0001	000021	141G	0001	000054	177G	0001	000358	20L
0001	000046	205G	0001	000104	214G	0001	000104	277G	0001	000121	230G	0001	000121	232G
0001	000133	241G	0001	000133	242G	0001	000145	252G	0001	000145	254G	0001	000370	30L
0001	000223	313G	0001	000220	317G	0001	000242	325G	0001	000247	331G	0001	000307	353G
0001	000321	361G	0001	000323	367G	0001	000351	376G	0001	000451	40L	0001	000364	404G
0001	000403	417G	0001	000415	425G	0001	000433	435G	0001	000445	443G	0001	000174	461G
0001	000501	465G	0001	000518	476G	0001	000523	502G	0001	000535	510G	0001	000542	514G
0001	000554	522G	0001	000561	526G	0001	000573	534G	0001	000605	542G	0001	000624	552G
0001	000631	556G	0001	000636	562G	0001	000643	566G	0001	000650	572G	0001	000642	600G
0001	000647	604G	0001	000674	610G	0001	000701	614G	0001	000706	620G	0001	000722	630G
0001	000736	640G	0001	001001	666G	0001	001020	700G	0001	000020	901F	0000	000026	902F
0000	000030	903F	0000	000035	904F	0000	000053	905F	0000	000110	905F	0000	000126	907F
0000	000134	908F	0000	000245	909F	0000	000253	910F	0000	000305	911F	0000	000306	912F
0000	000346	913F	0000	000356	914F	0000	000514	919F	0000	000407	914F	0000	000414	917F
0000	000464	918F	0000	000453	924F	0000	000525	925F	0000	000532	921F	0000	000601	922F
0000	000613	923F	0000	000720	929F	0000	000641	925F	0000	000711	926F	0000	000713	927F
0000	000716	928F	0000	000720	929F	0000	000730	930F	0000	000711	926F	0000	000713	927F
0000	000727	929F	0000	000720	929F	0000	000730	930F	0000	000711	926F	0000	000713	927F
0007	000027	BETA	0004	000013	BETA	0004	000023	BP	0004	000005	CP	0005	000030	ALPHA
0004	000004	ETR	0004	000015	FF	0005	000042	FHEXT	0004	000005	IPLOPT	0004	000002	IAC
0005	000024	TH	0003	000071	INER	0000	000745	INJPS	0010	000016	I	0004	000004	IPROPT
0005	000040	1XF	0000	000077	J	0004	000014	KC	0007	000005	KF	0007	000000	KG
0005	000022	KF	0007	000014	KR	0007	000030	KRC	0007	000006	LC	0004	000007	LPM
0004	000004	LN	0004	000005	LO	0007	000001	MP	0003	000003	MT	0005	000041	NFFREQ
0004	000004	LN	0005	000006	OMEGAC	0005	000050	OMEGAF	0007	000000	OMEGAS	0007	000045	OMEGAY
0004	000037	NFFREQ	0010	000002	OUTF4	0010	000000	PS	0003	000007	RXA	0003	000310	RZA
0007	000050	OMEGPF	0005	000003	TEAO	0010	000001	TEND	0000	000000	TITLE	0010	000000	TSTART
0005	000000	TCSGO												

REPRODUCIBILITY OF THIS  
ORIGINAL PAGE IS POOR

D2-118544-2

0007 R 000044 ZETAV

0007 R 000042 ZETAS

0004 R 000000 ZETAE

0003 R 000024 YZF

0006 R 000003 VO

ROUTINE TO READ THE CARD INPUT

10	C	ROUTINE TO READ THE CARD INPUT
00100	10	
00100	20	SUBROUTINE DATARD
00101	30	REAL MT, INER, HP, IAC, LCL, LR, LO, LPH, KCC, KG, KF, KR, KPF, KRC
00103	40	COMMON / INGEOD / MI, INER, G1, RXA, RYZA(2,6), ZF(2,6)
00104	50	COMMON / ACSTRO / ZETA, HP, IAC, LCL, LR, LO, EIR, LPM
00105	60	COMMON / ACFEND / TCGO(3), TEAD(3), OMEGAC(18), DLTAL(6), IM, NFREQ,
00106	70	IXF, NFREQ, FMTX(6), OMEGAF(18)
00106	80	COMMON / HYDRD / PS, A1(2), VO(2), CP(6), BETAE, KC, FF(6), BP(6)
00107	90	COMMON / ELED / KG(6), KF(6), KR(6), KPF(6), KRC(6), ALPHA, BETA,
00110	100	OMEGPF(2), ZETAS, OMEGAS, ZETAV, OMEGAV
00111	110	COMMON / NIBTC / TSTART, TEND, OUTFRQ(2), IPROPT, IPLOPY
00112	120	DIMENSION TITLE(4)
00113	130	COMMON / INERTIA AND GEOMETRY DATA
00114	140	901 FORMAT(10X, 5X, 'INERTIA AND GEOMETRY DATA')
00115	150	902 FORMAT(10X, 5X, 'TABLE MASS', T60, G11.5)
00116	160	903 FORMAT(10X, 5X, 'TABLE MOMENTS AND PRODUCTS OF INERTIA',
00117	170	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00118	180	904 FORMAT(10X, 5X, 'TABLE STATION OF ACTUATOR 5-LEVEL JOINTS',
00119	190	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00120	200	905 FORMAT(10X, 5X, 'TABLE C-G, T20, G11.5)
00121	210	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00122	220	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00123	230	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00124	240	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00125	250	907 FORMAT(10X, 5X, 'ACTUATOR STRUCTURAL DATA',
00126	260	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00127	270	908 FORMAT(10X, 5X, 'ACTUATOR BENDING DAMPING CONSTANT',
00128	280	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00129	290	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00130	300	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00131	310	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00132	320	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00133	330	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00134	340	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00135	350	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00136	360	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00137	370	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00138	380	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00139	390	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00140	400	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00141	410	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00142	420	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00143	430	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00144	440	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00145	450	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00146	460	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00147	470	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00148	480	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00149	490	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00150	500	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00151	510	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00152	520	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)
00153	530	12X, 'FOR ACTIVE TABLE SYSTEM', T60, G11.5)

```

00133 540 4 10X*ACTUATOR VISCIOUS DAMPING COEFFICIENT* T60,6G11.5/
00134 550 918 FORMAT(10X,ACTUATOR PUSH AND PULL STROKE WORKING AREA$T60,2G11.5/
00135 560 1 10X*INITIAL HYDRAULIC VOLUMES OF*/ T60,2G11.5/
00136 570 12X*FULLY RETRACTED ACTUATOR* T60,2G11.5/
00137 580 919 FORMAT(10X,COULOMB FRICTION FORCE OF ACTUATORS* T60,6G11.5/
00138 590 920 FORMAT(//,59X, ELECTRONICS DATA*/
00139 600 921 FORMAT(//,10X,GAINS*/
00140 610 1 12X*ELECTRONICS AND VALVE FORWARD LOOP* T60,6G11.5/
00141 620 2 12X*DISPLACEMENT FEEDBACK AND COMMAND* T60,6G11.5/
00142 630 3 12X*VELOCITY FEEDBACK LOOP* T60,6G11.5/
00143 640 4 12X*PRESSURE FEEDBACK LOOP* T60,6G11.5/
00144 650 5 12X*VELOCITY COMMANDS* T60,6G11.5/
00145 660 922 FORMAT(10X,BREAK FREQUENCIES OF FIRST ORDER FILTERS* T60,6G11.5/
00146 670 923 FORMAT(10X,DISPLACEMENT AND VELOCITY FEEDBACK*/
00147 680 1 12X*SECOND ORDER FILTER DAMPING CONSTANT*/ T60,2G11.5/
00148 690 2 12X*AND FREQUENCY* T60,2G11.5/
00149 700 3 12X*VALVE DYNAMICS DAMPING CONSTANT*/ T60,2G11.5/
00150 710 4 12X*AND FREQUENCY* T60,2G11.5/
00151 720 924 FORMAT(//,59X, PROGRAM CONTROL DATA*/
00152 730 925 FORMAT(//,10X,START TIME* T60, G11.5/
00153 740 1 10X*STOP TIME* T60, G11.5/
00154 750 2 10X*OUTPUT FREQUENCIES* T60,2G11.5/
00155 760 3 10X*PRINT OPTION* T60,14/
00156 770 4 10X*PLOT OPTION* T60,14/
00157 780 926 FORMAT(13A6,A2)
00158 790 927 FORMAT(11,2A3,13A6,A2)
00159 800 928 FORMAT(10X,EXTERNAL FORCES AND MOMENTS* T60,6G11.5/
00160 810 929 FORMAT(10X,EXTERNAL FORCE FREQUENCIES* T60,6G11.5/
00161 820 930 FORMAT(10X,EXTERNAL FORCE FREQUENCIES* T60,6G11.5/
00162 830 READ(5,926,END=100) TITLE
00163 840 WRITE(6,927) TITLE
00164 850 C
00165 860 C
00166 870 C
00167 880 C
00168 890 C
00169 900 C
00170 910 C
00171 920 C
00172 930 C
00173 940 C
00174 950 C
00175 960 C
00176 970 C
00177 980 C
00178 990 C
00179 1000 C
00180 1010 C
00181 1020 C
00182 1030 C
00183 1040 C
00184 1050 C
00185 1060 C
00186 1070 C
00187 1080 C
00188 1090 C
00189 1100 C
00190 1110 C

```

```

00367 1120 WRITE(6,913) (OMEGAF(I),I=1,NFREQ)
00368 1130 READ(5,902) (DLTAI(I),I=1,6)
00369 1140 IF (OMEGAF(1).GT.0.) GO TO 20
00370 1150 WRITE(6,914) DLTAI
00371 1160 GO TO 30
00372 1170 20 WRITE(6,915) DLTAI
00373 1180 30 CONTINUE
00374 1190 IF (IXF.EQ.0) GO TO 40
00375 1200 READ(5,902) FMEAT
00376 1210 WRITE(6,921) FMEAT
00377 1220 IF (IXF.EQ.1) GO TO 40
00378 1230 READ(5,902) (OMEGAF(I),I=1,NFREQ)
00379 1240 WRITE(6,930) (OMEGAF(I),I=1,NFREQ)
00380 1250 40 CONTINUE
00381 1260 C
00382 1270 C HYDRAULICS DATA
00383 1280 C
00384 1290 WRITE(6,916)
00385 1300 READ(5,902) PS,BETA,KC
00386 1310 READ(5,902) CP,BP
00387 1320 WRITE(6,917) PS,BETA,KC,CP,BP
00388 1330 READ(5,902) (A(I),I=1,2),(VO(I),I=1,2)
00389 1340 WRITE(6,918) A,VO
00390 1350 READ(5,902) (FF(I),I=1,6)
00391 1360 WRITE(6,919) FF
00392 1370 C
00393 1380 C ELECTRONICS DATA
00394 1390 C
00395 1400 WRITE(6,920)
00396 1410 READ(5,902) KG,KF,KR,KPF,KRC
00397 1420 WRITE(6,921) KG,KF,KR,KPF,KRC
00398 1430 READ(5,902) ALPHA,BETA,OMEGAP
00399 1440 WRITE(6,922) ALPHA,BETA,OMEGAP
00400 1450 READ(5,902) ZETAS,OMEGAS,ZETAV,OMEGAV
00401 1460 WRITE(6,923) ZETAS,OMEGAS,ZETAV,OMEGAV
00402 1470 C
00403 1480 C PROGRAM CONTROL DATA
00404 1490 C
00405 1500 WRITE(6,924)
00406 1510 READ(5,928) TSTART,TEND,OUTFRQ,IPROPT,IPLOPT
00407 1520 WRITE(6,925) TSTART,TEND,OUTFRQ,IPROPT,IPLOPT
00408 1530 RETURN
00409 1540 100 CONTINUE
00410 1550 STOP
00411 1560 END

```

END OF COMPILATION: NO DIAGNOSTICS.

DATA	CODE	SYMBOLIC	RELOCATABLE	31 JAN 74	21:52:34	0	0152476	14	156	(DELETED)
DATA	CODE	SYMBOLIC	RELOCATABLE	31 JAN 74	21:52:34	0 <td>0152476</td> <td>48</td> <td>1</td> <td>(DELETED)</td>	0152476	48	1	(DELETED)
DATA	CODE	SYMBOLIC	RELOCATABLE	31 JAN 74	21:52:34	0 <td>0152476</td> <td>14</td> <td>102</td> <td></td>	0152476	14	102	

REPRODUCIBILITY OF THE  
ORIGINAL PAGE IS POOR

29 JUN 74 5:35:21.53

R FOR: FCH, FCH  
UNIVAC II FOR: FCH, V EXEC, V LEVEL 25A - (KASCA LEVEL F12010010A)  
THIS COMPILATION WAS DONE ON 29 JUN 74 AT 05135121

SUBROUTINE FCH ENTRY POINT: 000254

STORAGE USED: COB(1) 0002651, DATA(0) 0001211, BLANK COMMON(2) 0000020

## COMMON BLOCKS:

0003 NRKVS1 000264  
0004 NTGRID 000006  
0005 NTGRIC 000003  
0006 FACHND 000040  
0007 ECHC 000022  
0008 MASS 000504  
0009 ACSTRD 000010  
0010 ACALVA 000006

## EXTERNAL REFERENCES (BLOCK, NAME)

0013 ACDCV  
0014 ACXAP  
0015 AC180  
0016 TTRANS  
0017 MTRAK  
0020 SJR  
0021 CFM  
0022 COLUN  
0023 AMTRX  
0024 MYSRE  
0025 OUTPUT  
0026 COS  
0027 SIN  
0028 HROUE  
0031 H1025  
0032 HERR38

## STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000042 1340 0001 000245 1408 0001 000032 1426 0001 000034 1543 0001 000077 1600  
0001 000206 1600 0001 000222 1702 0001 000145 2006 0001 000234 200L 0001 000012 40L  
0001 000032 50L 0000 000031 7007 0000 000044 901F 0000 000034 A 0004 000001 EXFRQ  
0001 000000 C 0000 000037 90 0000 000041 CS 0001 000004 EIR 0004 000004 IFIRST  
0001 000000 FILL 0000 000000 FRNCEY 0000 000035 I 0001 000002 IAC 0000 000002 IX  
0000 000000 IND 0000 000000 INDXR 0000 000104 INJAE 0001 000004 LR  
0001 000036 14 0000 000000 JC 0001 000003 LC 0001 000007 LPH 0001 000002 OUTFRQ  
0001 000036 J 0000 000000 H 0001 000001 MP 0000 000037 HPRCO 0000 000003 TPLOT  
0001 000005 LD 0000 000000 M 0001 000001 TEND 0000 000000 TIME 0000 000003 XDOT  
0000 000003 PL 0000 000000 SF 0000 000000 TEND 0000 000000 X  
0000 000003 PRINT 0000 000000 TSTART 0000 000000 X  
0001 000000 ZTAE

64

REPRODUCIBILITY OF THE  
ORIGINAL PAGE IS POOR

```

00209 580 IF (PL) 100,110,110
00207 590 110 IF (PL-GRH) 120,120,180
00212 600 120 CONTINUE
00214 610 CALL OUTPUT
00215 620 RETURN
00216 630 180 WRITE(6,201,1X)
00221 640 901 FORMAT(//10X 'ACTUATOR 13' WAS STORED OUT... ABORT AND GO TO :
00221 650 110 NEXT CASE,11)
00222 660 TPRINT = TIME
00223 670 TPLOT = TIME
00224 680 CALL OUTPUT
00225 690 GO TO 200
00228 700 190 WRITE(6,900)
00230 710 900 FORMAT(// 10X 'ERROR WHILE INVERTING MASS MATRIX... :
00230 720 1 'GO TO NEXT CASE ')
00231 730 TPRINT = TIME
00232 740 TPLOT = TIME
00233 750 CALL OUTPUT
00234 760 200 INKTR = 1
00235 770 RETURN
00236 780 END

```

END OF COMPILATION! NO DIAGNOSTICS.

PCN CODE RELOCATABLE

28 JAN 74 25127118 0 01810738 14 78 (DELETED)  
 28 JAN 74 23227118 1 01813042 72 1 (DELETED)  
 0 01813152 14 24



29 JUN 74 5:35:23.172

FOR: GONADS, GONADS  
UNIVAC 1100 FORTRAN V EXEC 11 LEVEL 25A - (EXEC LEVEL 212010010A)  
THIS COMPILATION WAS DONE ON 29 JUN 74 AT 0535123

## MAIN PROGRAM

STORAGE USED: CODE(1) 000067; DATA(0) 000026; BLANK COMMON(2) 000000

## COMMON BLOCKS:

0003 INITLC 000132  
0004 INITLC 000002  
0005 FRCPND 000042  
0006 NRKVS1 000266

## EXTERNAL REFERENCES (BLOCK, NAME)

0007 FCN  
0010 DAYARD  
0011 INITLC  
0012 RKINIT  
0013 NRKVS  
0014 PLOTEN  
0015 MRDUS  
0016 NI023  
0017 NSTOPS

## STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000050 100L 0001 000022 1146 0001 000025 1176 0001 000054 150L 0001 000000 20L  
0000 000000 100F 0000 000000 FCN 0000 000000 FILL 0000 000003 IN 0000 000025 INO  
0000 000000 10F 0000 000000 L 0000 000000 LOOP 0000 000002 M 0000 000001 NPFREQ  
0000 000000 10F 0000 000000 L 0000 000000 LOOP 0000 000002 M 0000 000001 NPFREQ  
0000 000000 10F 0000 000000 L 0000 000000 TIME 0000 000000 TSTART 0000 000001 X  
0000 000000 10F 0000 000000 L 0000 000000 TIME 0000 000000 TSTART 0000 000001 X  
0000 000000 10F 0000 000000 L 0000 000000 X0 0000 000000 X0

## MAIN PROGRAM

00100 10 C MAIN PROGRAM  
00100 20 C  
00101 30 EXTERNAL FCN  
00102 40 COMMON /INITLC/ X01901  
00103 50 COMMON /HYPERC/ TSTART, TEND  
00104 60 COMMON /FRCPND/ FILL(3), NPFREQ, 10F, NPFREQ  
00105 70 COMMON /NRKVS1/ TIME, X01901, X001V01, TEND  
00106 80 C  
00107 90 20 CALL DAYARD  
00108 100 LOOP = 1  
00109 110 IF (X01901.EQ.2) LOOP = NPFREQ  
00110 120 DO 200 L=1, NPFREQ  
00111 130 DO 200 M=1, LOOP  
00112 140 C  
00113 150 CALL INITLC(L,M)  
00114 160 CALL RKINIT  
00115 170 IN = 0  
00116 180 CALL NRKVS(1000, TSTART, TEND, X0, X01901, IN, FCN)  
00117 190  
00118 200

	END OF COMPI	N1	NO DIAGNOSTICS.		
SQUADS	SYMBOLIC				
COMADS CODE	RELOCATABLE				
		28 JAN 74	23:27:16	0 01507720	14
		28 JAN 74	23:27:16	1 01510474	34
				0 01510340	14
					9
					24 (DELETED)
					1 (DELETED)
					9 (DELETED)

29 JUN 74 5:35:29.386

FOR: HYSREL, HYSREL  
UNIVAC 1108 FORTRAN V EXEC 11 LEVEL 25A -LEXECB LEVEL E[2010010A]  
THIS COMPILATION WAS DONE ON 29 JUN 74 AT 05:35:29

SUBROUTINE HYSREL ENTRY POINT 000302

STORAGE USED: CODE(1) 000316; DATA(1) 000040; BLANK COMMON(2) 000000

COMMON BLOCKS:

0003 ACSTRP 000010  
0004 ACLVA 000044  
0005 ACVAC 000022  
0006 HYDRD 000031  
0007 ELECD 000044  
0010 MKVSI 000245

EXTERNAL REFERENCES (BLOCK, NAME)

0011 DENTRY  
0012 MERR32

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000122 100L 0001 000017 1146 0001 000255 140L 0001 000034 30L  
0001 000047 40L 0001 000022 70L 0001 000105 90L 0004 R 000001 A 0004 R 000014 AA  
0004 R 000000 AL 0007 R 000036 ALPHA 0004 R 000004 AV 0007 R 000037 BETA 0006 R 000013 BETAE  
0004 000023 BP 0006 R 000014 CAA 0005 R 000020 CAL 0005 R 000006 CAV 0006 R 000005 CP  
0000 R 000001 DELTA 0000 R 000007 DELTAD 0003 000004 EIR 0000 R 000002 FACV 0006 000015 FF  
0000 I 000000 I 0003 050002 IAC 0000 000012 INJPS 0000 I 000004 J 0000 I 000006 K  
0006 R 000014 KC 0007 R 000006 KF 0007 R 000005 KG 0007 R 000022 KPF 0007 R 000014 KR  
0007 R 000030 KRC 0003 000003 LC 0003 000007 LPH 0003 R 000004 LR 0003 R 000005 LO  
0003 000001 HP 0007 R 000043 OMEGAS 0007 R 000045 OMEGAV 0007 R 000040 OMEGPF 0000 R 000003 PL  
0006 000000 PS 0004 000022 RS 0000 R 000003 TERM 0010 000000 TIME 0006 R 000003 VO  
0010 R 000001 X 0010 R 000133 XDOT 0003 000000 ZETA 0007 R 000002 ZETAS 0007 R 000044 ZETAV

00101 10 SUBROUTINE HYSREL  
00101 20 C ROUTINE TO COMPUTE HYDRAULIC AND SERVO ELECTRONIC DERIVATIVES  
00101 30 C  
00101 40 C

00103 50 REAL KC,KG,KR,LO,KRC,KPF,KF  
00104 60 COMMON /ACSTRP/ ZETA,IMP,IAC,LC,LK,LO,TEIR,LPH  
00105 70 \*COMMON /ACLVA / AL(4),AV(4),AL(6),RS(3,6)  
00106 80 COMMON /ACVAC/ CAL(4),CAV(4),CAA(4)  
00107 90 COMMON /HYDRD / PS,AI2,VOI2,CP(4),BETAE,KC,FF(4),BP(4)  
00110 100 COMMON /ELECD / KGT,KFT(6),KRC(6),KPT(6),KRC(6),ALPHA,BETA,  
00111 110 OMEGPF(2),ZETAS,OMEGAS,ZETAV,OMEGAV  
00112 120 1 COMMON /MKVSI/ TIME,X(90),XDOT(90)  
00113 130 CALL DENTRY  
00113 140 DO 140 1014  
00113 150 C

## C FILTERED ACTUATOR FEEDBACK VELOCITIES

```

00113 160 C
00114 170 C
00115 180 IF(OMEGAS=1) 20,20,30
00116 190 20 XDOT(1:60) = AA(1)
00117 200 X(1:60) = AV(1)
00118 210 X(1:60) = AL(1)
00119 220 XDOT(1:60) = AV(1)
00120 230 GO TO 40
00121 240 30 XDOT(1:60) = OMEGAS*2*AL(1)+2*ZETAS/OMEGAS*X(1:60)-X(1:60)
00122 250 XDOT(1:60) = X(1:60)
00123 260 C
00124 270 C
00125 280 40 IF(BETA=1) 50,50,70
00126 290 50 DELTA = KEL*CAL(1)+KRC(1)*CAV(1)
00127 300 X(1:84) = DELTA-X(1:78)-KR(1)*X(1:60)-KF(1)*X(1:66)
00128 310 XDOT(1:84) = 0
00129 320 C NO-LOAD VALVE FLOWS
00130 330 C
00131 340 70 IF(OMEGAV=1) 80,80,90
00132 350 80 X(1:54) = KG(1)*X(1:84)
00133 360 XDOT(1:54) = 0
00134 370 X(1:48) = 0
00135 380 XDOT(1:54) = 0
00136 390 GO TO 100
00137 400 90 XDOT(1:48) = OMEGAV*2*(KG(1)*X(1:84)+2*ZETAV*X(1:48)
00138 410 /OMEGAV-X(1:54))
00139 420 XDOT(1:54) = X(1:48)
00140 430 C
00141 440 C PUSH AND PULL HYDRAULIC PRESSURE ON ACTUATOR PISTONS
00142 450 C
00143 460 C
00144 470 100 CONTINUE
00145 480 FACT = 1
00146 490 PL = AL(1)-LQ
00147 500 DO 110 J=1,2
00148 510 TERM = -CP(1)*X(1:34)-X(1:42)-A(J)*AV(1)
00149 520 IF(J=2) FACT = -1
00150 530 K = 6*(J-1)+36
00151 540 110 XDOT(K+1) = BETAE/IVQ(J)*FACT*A(J)*PL
00152 550 IF(FACT*X(1:54)-2*KC*X(K+1)+FACT*TERM)
00153 560 C
00154 570 C PRESSURE FEEDBACK
00155 580 C
00156 590 XDOT(1:72) = OMEGPF(1)*KPF(1)*(X(1:36)-X(1:42))-X(1:72)
00157 600 XDOT(1:78) = OMEGPF(2)*(XDOT(1:72)-X(1:78))
00158 610 C
00159 620 C VOLTAGE OUTPUT OF FORWARD LOOP COMPENSATION FILTERS
00160 630 C
00161 640 IF(BETA=1) 140,140,120
00162 650 130 DELTA = KF(1)*CAL(1)+KRC(1)*CAV(1)
00163 660 DELTAD = KF(1)*CAV(1)+KRC(1)*CAA(1)
00164 670 XDOT(1:84) = BETAE*(DELTAD-XDOT(1:78))-KR(1)*XDOT(1:60)
00165 680 -KF(1)*X(1:60)/ALPHA*(DELTAD-X(1:78)-KR(1)*X(1:60)
00166 690 -KF(1)*X(1:66)-X(1:94))
00167 700 140 CONTINUE
00168 710 RETURN
00169 720 END

```

END OF COMPILATION: NO DIAGNOSTICS.

MYSEL SYMBOLIC  
MYSEL CODE RELOCATABLE

05 SEP 73 14:21:14 0 01420476 14 72 (DELETED)  
05 SEP 73 14:21:14 1 01422456 48 1 (DELETED)  
0 01422536 14 23

29 JUN 74 5:35:26.300

0 FOR INITIATION  
UNIVAC J108 FORTRAN V EXEC II LEVEL 25A -LEXECA LEVEL EL2010010A1  
THIS COMPILATION WAS DONE ON 29 JUN 74 AT 05:35:26

SUBROUTINE INITIATION ENTRY POINT 000114

STORAGE USED: CODE(1) 0001271 DATA(0) 0001101 BLANK COMMON(2) 000000

COMMON BLOCKS:

0003 FRCFND 000072  
0004 HYDRO 000031  
0005 NIGRTC 000004  
0006 NIGRTD 000004  
0007 NITILC 000132  
0010 MASS 000504  
0011 NRKVS1 000245  
0012 ELEC 000036  
0013 PLOT 000001

EXTERNAL REFERENCES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0014 NRES  
0015 NRDUS  
0016 NIOZS  
0017 NERR3S

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000033 131G 0001 000041 140G 0001 000046 145G 0001 000047 151G 0001 000070 164G  
0000 000003 YOLF 0004 R 000001 A 0004 000013 BETAE 0004 000023 BP 0004 000005 CP  
0004 R 000001 EXFRQ 0004 000015 F 0005 000002 FILL 0003 000030 FILL 0004 R 000000 FRONCY  
0001 000001 I 0004 I 000004 TFIRST 0004 I 000005 INDKR 0000 000071 INJPS 0005 I 000005 IPLOPY  
0000 I 000002 J 0004 000014 KC 0012 000006 KF 0012 000000 KG 0012 R 000022 KPF  
0012 000014 KR 0012 000030 KRC 0010 I 000000 NPLTS 0013 I 000000 OMEGAC  
0003 R 000050 OMEGAF 0004 R 000000 PS 0005 R 000001 TEND 0011 000000 TIME 0004 R 000003 TPLOT  
0004 R 000002 TPRINT 0005 R 000000 TSTART 0000 R 000000 VBN 0004 000003 VO 0011 R 000001 X  
0011 R 000133 XDOT 0003 R 000000 XI 0007 R 000000 XO

00101 10 SUBROUTINE INITIATION (IFREQ, IFFREQ)  
00102 20 COMMON /FRCFND/ XI(6), OMEGAC(18), FILL(116), OMEGAF(18)  
00103 30 COMMON /HYDRO/ PS, A(2), VO(2), CP(3), BETAE, KC, FF(6), BP(6)  
00104 40 COMMON /NIGRTC/ TSTART, TEND, FILL(3), IPLOPY  
00105 50 COMMON /NIGRTD/ FRONCY, EXFRQ, TPRINT, TPLOT, IFIRST, INDKR  
00106 60 COMMON /NITILC/ XDOT(90)  
00107 70 COMMON /MASS/ M(18,18)  
00110 80 COMMON /NRKVS1/ TIME, X(90), XDOT(90)  
00111 90 COMMON /ELEC/ KG(6), KPF(6), KRC(6)  
00112 100 COMMON /PLOT/ NPLTS  
00113 110 REAL KPF  
00114 120 DATA VBN /, 005/  
00115 120

END OF COMPILATION:		NO DIAGNOSTICS:	
INITIAL	SYMBOLIC		
INITIAL	RELOCATABLE		

D2-118544-2

5335127-491

29 JUN 74

FOR O MATRI, MATRI  
INPUT SOURCE LANGUAGE ELEMENT NOT AVAILABLE



-29 JUN 74 5:35:27.535

FOR M33M3X3  
UNIVAC 1108 FORTRAN V EXEC II LEVEL 25A --(EXEC8 LEVEL E12010010A)  
THIS COMPILATION WAS DONE ON 29 JUN 74 AT 05:35:27

SUBROUTINE M333 ENTRY POINT 000047

STORAGE USED: CODE(1) 000044; DATA(0); 0000241 BLANK COMMON(2) 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NEAR33

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000005 1056 0001 000010 1106 0001 000012 1146 0000 000000 1 0000 000005 1106

0000 1 000001 J 0000 1 000002 K

00101 10 SUBROUTINE M333(A,B,C)

00102 20 DIMENSION A(3,3),B(3,3),C(3,3)

00103 30 DO 10 I=1,3

00104 40 DO 10 J=1,3

00105 50 C(I,J) = 0.

00106 60 DO 10 K=1,3

00107 70 10 C(I,J) = C(I,J)+A(I,K)\*B(K,J)

00108 80 RETURN

00109 90 END

END OF COMPILATION: NO DIAGNOSTICS.

M333 SYMBOLIC

M333 CODE RELOCATABLE

15 AUG 73 15:49:31 0 01442424 14 9 (DELETED)

15 AUG 73 15:49:31 1 01442424 24 1 (DELETED)

0 01442424 14 7

9 FOR: NRKVS,NRKVS 29 JUN 74 5:35:38.467  
 UNIVAC LIB EDITOR Y EXEC JJ LEVEL 25A -LEXECA LEVEL EL2010010AI  
 THIS COMPILATION WAS DONE ON 29 JUN 74 AT 05:35:28

SUBROUTINE NRKVS ENTRY POINT 001240

STORAGE USED: CODE(1) 001443; DATA(1) 001241 BLANK COMMON(2) 000000

COMMON BLOCKS:

0003 NRKVS1 000267  
 0004 NRKVS2 000264  
 0005 NRKVS3 000007  
 0006 NRGTD 000004

EXTERNAL REFERENCES (BLOCK, NAME)

0007 N-008  
 0010 N1018  
 0011 N1029  
 0012 NERR48  
 0013 NERR35

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000034	109L	0001	000040	108L	0001	000111	11L	0001	000045	120L	0001	000117	122L
0001	000124	123L	0001	000132	125L	0001	000045	144G	0001	000137	200L	0001	000150	215G
0001	000215	237G	0001	000230	246G	0001	000250	256G	0001	000275	270G	0001	000312	277G
0001	000170	300L	0001	000332	307G	0001	000347	316G	0001	000366	327G	0001	000402	336G
0001	000422	346G	0001	000437	355G	0001	000475	372G	0001	000445	400L	0001	000511	401G
0001	000531	411G	0001	000545	420G	0001	000574	432G	0001	000556	500L	0001	001001	506G
0001	000615	506L	0001	000646	510L	0001	000664	513L	0001	000711	514L	0001	000733	516L
0001	000736	518L	0001	000757	520L	0001	001041	526G	0001	001124	544G	0001	000773	608L
0001	001151	601G	0001	000774	610L	0001	001032	622L	0001	001037	624L	0001	001207	625G
0001	001055	636L	0001	001063	640L	0001	001247	650G	0001	001266	660G	0001	001271	664G
0001	001115	730L	0001	001117	702F	0001	001136	704F	0001	001150	706F	0001	001327	706G
0001	001172	708F	0001	001170	710L	0001	001220	712F	0001	001230	730L	0001	001256	742F
0001	001254	750L	0001	001303	760L	0001	001265	760F	0001	001061	A	0001	001101	AH
0001	001072	ADMIN	0005	R 000001	ADMINH	0001	R 001071	AMS	0005	R 000002	AMSTRT	0005	R 001132	AMAG
0001	R 001042	B	0001	R 001063	C	0001	R 001274	CHNG	0003	R 000131	D	0001	R 000234	DMIST
0001	R 001424	DIFF	0001	R 001060	DRHO	0001	R 001274	CHNG	0003	R 000266	ENDT	0004	R 000000	ERR
0001	R 001274	ERRSTD	0001	R 000000	FILL	0001	R 000550	FINAGL	0003	R 001102	M	0001	R 001106	M12
0001	R 001103	M2	0001	R 001105	M4	0001	R 001104	M6	0001	R 001064	I	0005	I 000000	IO1AG
0001	R 000245	INT	0001	R 000005	INXTR	0001	R 001601	INJPS	0001	R 001045	INTEG	0005	I 000003	INTFLG
0001	R 001073	INTEJG	0001	R 000555	IS7VE	0001	R 001115	J	0001	R 001116	K	0005	I 000004	MAXN
0001	R 000005	MFAIL	0005	R 000024	MS7EP2	0001	R 001100	M2ALLI	0001	R 001113	MSORT	0003	I 001076	NSTEP
0001	R 001077	NSTEP2	0001	R 001110	RE7P	0003	R 001055	REJECT	0001	R 001274	RETR	0001	R 001054	RETRN
0001	R 000542	RSAYE	0001	R 001114	SORT	0003	R 000000	I	0001	R 000567	TD	0001	R 001107	TEPR
0001	R 001075	TEST	0001	R 001111	TF1	0001	R 001112	TF2	0001	R 001070	TR	0001	R 001067	T5
0001	R 001074	TTEST	0001	R 001066	UPDS	0003	R 000001	K	0001	R 000571	XD	0001	R 000416	XHIST
0001	R 001057	XRHO	0001	R 001274	XS	0001	R 001426	Z	0001	R 000132	ZZ			

76

```

00201 580 122 AMS = D1*ABS(TP-TS)
00202 581 123 IF (AMHIN(125,125),24
00203 582 124 AMHIN = ABS(AMHIN)
00204 583 GO TO 200
00205 584 125 AMHIN = 1.E-5*ABS(TP-TS)
00206 585 C
00207 586 C
00208 587 C
00209 588 C
00210 589 C
00211 590 C
00212 591 C
00213 592 C
00214 593 C
00215 594 C
00216 595 C
00217 596 C
00218 597 C
00219 598 C
00220 599 C
00221 600 C
00222 601 C
00223 602 C
00224 603 C
00225 604 C
00226 605 C
00227 606 C
00228 607 C
00229 608 C
00230 609 C
00231 610 C
00232 611 C
00233 612 C
00234 613 C
00235 614 C
00236 615 C
00237 616 C
00238 617 C
00239 618 C
00240 619 C
00241 620 C
00242 621 C
00243 622 C
00244 623 C
00245 624 C
00246 625 C
00247 626 C
00248 627 C
00249 628 C
00250 629 C
00251 630 C
00252 631 C
00253 632 C
00254 633 C
00255 634 C
00256 635 C
00257 636 C
00258 637 C
00259 638 C
00260 639 C
00261 640 C
00262 641 C
00263 642 C
00264 643 C
00265 644 C
00266 645 C
00267 646 C
00268 647 C
00269 648 C
00270 649 C
00271 650 C
00272 651 C
00273 652 C
00274 653 C
00275 654 C
00276 655 C
00277 656 C
00278 657 C
00279 658 C
00280 659 C
00281 660 C
00282 661 C
00283 662 C
00284 663 C
00285 664 C
00286 665 C
00287 666 C
00288 667 C
00289 668 C
00290 669 C
00291 670 C
00292 671 C
00293 672 C
00294 673 C
00295 674 C
00296 675 C
00297 676 C
00298 677 C
00299 678 C
00300 679 C
00301 680 C
00302 681 C
00303 682 C
00304 683 C
00305 684 C
00306 685 C
00307 686 C
00308 687 C
00309 688 C
00310 689 C
00311 690 C
00312 691 C
00313 692 C
00314 693 C
00315 694 C
00316 695 C
00317 696 C
00318 697 C
00319 698 C
00320 699 C
00321 700 C
00322 701 C
00323 702 C
00324 703 C
00325 704 C
00326 705 C
00327 706 C
00328 707 C
00329 708 C
00330 709 C
00331 710 C
00332 711 C
00333 712 C
00334 713 C
00335 714 C
00336 715 C
00337 716 C
00338 717 C
00339 718 C
00340 719 C
00341 720 C
00342 721 C
00343 722 C
00344 723 C
00345 724 C
00346 725 C
00347 726 C
00348 727 C
00349 728 C
00350 729 C
00351 730 C
00352 731 C
00353 732 C
00354 733 C
00355 734 C
00356 735 C
00357 736 C
00358 737 C
00359 738 C
00360 739 C
00361 740 C
00362 741 C
00363 742 C
00364 743 C
00365 744 C
00366 745 C
00367 746 C
00368 747 C
00369 748 C
00370 749 C
00371 750 C
00372 751 C
00373 752 C
00374 753 C
00375 754 C
00376 755 C
00377 756 C
00378 757 C
00379 758 C
00380 759 C
00381 760 C
00382 761 C
00383 762 C
00384 763 C
00385 764 C
00386 765 C
00387 766 C
00388 767 C
00389 768 C
00390 769 C
00391 770 C
00392 771 C
00393 772 C
00394 773 C
00395 774 C
00396 775 C
00397 776 C
00398 777 C
00399 778 C
00400 779 C
00401 780 C
00402 781 C
00403 782 C
00404 783 C
00405 784 C
00406 785 C
00407 786 C
00408 787 C
00409 788 C
00410 789 C
00411 790 C
00412 791 C
00413 792 C
00414 793 C
00415 794 C
00416 795 C
00417 796 C
00418 797 C
00419 798 C
00420 799 C
00421 800 C
00422 801 C
00423 802 C
00424 803 C
00425 804 C
00426 805 C
00427 806 C
00428 807 C
00429 808 C
00430 809 C
00431 810 C
00432 811 C
00433 812 C
00434 813 C
00435 814 C
00436 815 C
00437 816 C
00438 817 C
00439 818 C
00440 819 C
00441 820 C
00442 821 C
00443 822 C
00444 823 C
00445 824 C
00446 825 C
00447 826 C
00448 827 C
00449 828 C
00450 829 C
00451 830 C
00452 831 C
00453 832 C
00454 833 C
00455 834 C
00456 835 C
00457 836 C
00458 837 C
00459 838 C
00460 839 C
00461 840 C
00462 841 C
00463 842 C
00464 843 C
00465 844 C
00466 845 C
00467 846 C
00468 847 C
00469 848 C
00470 849 C
00471 850 C
00472 851 C
00473 852 C
00474 853 C
00475 854 C
00476 855 C
00477 856 C
00478 857 C
00479 858 C
00480 859 C
00481 860 C
00482 861 C
00483 862 C
00484 863 C
00485 864 C
00486 865 C
00487 866 C
00488 867 C
00489 868 C
00490 869 C
00491 870 C
00492 871 C
00493 872 C
00494 873 C
00495 874 C
00496 875 C
00497 876 C
00498 877 C
00499 878 C
00500 879 C
00501 880 C
00502 881 C
00503 882 C
00504 883 C
00505 884 C
00506 885 C
00507 886 C
00508 887 C
00509 888 C
00510 889 C
00511 890 C
00512 891 C
00513 892 C
00514 893 C
00515 894 C
00516 895 C
00517 896 C
00518 897 C
00519 898 C
00520 899 C
00521 900 C
00522 901 C
00523 902 C
00524 903 C
00525 904 C
00526 905 C
00527 906 C
00528 907 C
00529 908 C
00530 909 C
00531 910 C
00532 911 C
00533 912 C
00534 913 C
00535 914 C
00536 915 C
00537 916 C
00538 917 C
00539 918 C
00540 919 C
00541 920 C
00542 921 C
00543 922 C
00544 923 C
00545 924 C
00546 925 C
00547 926 C
00548 927 C
00549 928 C
00550 929 C
00551 930 C
00552 931 C
00553 932 C
00554 933 C
00555 934 C
00556 935 C
00557 936 C
00558 937 C
00559 938 C
00560 939 C
00561 940 C
00562 941 C
00563 942 C
00564 943 C
00565 944 C
00566 945 C
00567 946 C
00568 947 C
00569 948 C
00570 949 C
00571 950 C
00572 951 C
00573 952 C
00574 953 C
00575 954 C
00576 955 C
00577 956 C
00578 957 C
00579 958 C
00580 959 C
00581 960 C
00582 961 C
00583 962 C
00584 963 C
00585 964 C
00586 965 C
00587 966 C
00588 967 C
00589 968 C
00590 969 C
00591 970 C
00592 971 C
00593 972 C
00594 973 C
00595 974 C
00596 975 C
00597 976 C
00598 977 C
00599 978 C
00600 979 C
00601 980 C
00602 981 C
00603 982 C
00604 983 C
00605 984 C
00606 985 C
00607 986 C
00608 987 C
00609 988 C
00610 989 C
00611 990 C
00612 991 C
00613 992 C
00614 993 C
00615 994 C
00616 995 C
00617 996 C
00618 997 C
00619 998 C
00620 999 C
00621 1000 C
00622 1001 C
00623 1002 C
00624 1003 C
00625 1004 C
00626 1005 C
00627 1006 C
00628 1007 C
00629 1008 C
00630 1009 C
00631 1010 C
00632 1011 C
00633 1012 C
00634 1013 C
00635 1014 C
00636 1015 C
00637 1016 C
00638 1017 C
00639 1018 C
00640 1019 C
00641 1020 C
00642 1021 C
00643 1022 C
00644 1023 C
00645 1024 C
00646 1025 C
00647 1026 C
00648 1027 C
00649 1028 C
00650 1029 C
00651 1030 C
00652 1031 C
00653 1032 C
00654 1033 C
00655 1034 C
00656 1035 C
00657 1036 C
00658 1037 C
00659 1038 C
00660 1039 C
00661 1040 C
00662 1041 C
00663 1042 C
00664 1043 C
00665 1044 C
00666 1045 C
00667 1046 C
00668 1047 C
00669 1048 C
00670 1049 C
00671 1050 C
00672 1051 C
00673 1052 C
00674 1053 C
00675 1054 C
00676 1055 C
00677 1056 C
00678 1057 C
00679 1058 C
00680 1059 C
00681 1060 C
00682 1061 C
00683 1062 C
00684 1063 C
00685 1064 C
00686 1065 C
00687 1066 C
00688 1067 C
00689 1068 C
00690 1069 C
00691 1070 C
00692 1071 C
00693 1072 C
00694 1073 C
00695 1074 C
00696 1075 C
00697 1076 C
00698 1077 C
00699 1078 C
00700 1079 C
00701 1080 C
00702 1081 C
00703 1082 C
00704 1083 C
00705 1084 C
00706 1085 C
00707 1086 C
00708 1087 C
00709 1088 C
00710 1089 C
00711 1090 C
00712 1091 C
00713 1092 C
00714 1093 C
00715 1094 C
00716 1095 C
00717 1096 C
00718 1097 C
00719 1098 C
00720 1099 C
00721 1100 C
00722 1101 C
00723 1102 C
00724 1103 C
00725 1104 C
00726 1105 C
00727 1106 C
00728 1107 C
00729 1108 C
00730 1109 C
00731 1110 C
00732 1111 C
00733 1112 C
00734 1113 C
00735 1114 C
00736 1115 C
00737 1116 C
00738 1117 C
00739 1118 C
00740 1119 C
00741 1120 C
00742 1121 C
00743 1122 C
00744 1123 C
00745 1124 C
00746 1125 C
00747 1126 C
00748 1127 C
00749 1128 C
00750 1129 C
00751 1130 C
00752 1131 C
00753 1132 C
00754 1133 C
00755 1134 C
00756 1135 C
00757 1136 C
00758 1137 C
00759 1138 C
00760 1139 C
00761 1140 C
00762 1141 C
00763 1142 C
00764 1143 C
00765 1144 C
00766 1145 C
00767 1146 C
00768 1147 C
00769 1148 C
00770 1149 C
00771 1150 C
00772 1151 C
00773 1152 C
00774 1153 C
00775 1154 C
00776 1155 C
00777 1156 C
00778 1157 C
00779 1158 C
00780 1159 C
00781 1160 C
00782 1161 C
00783 1162 C
00784 1163 C
00785 1164 C
00786 1165 C
00787 1166 C
00788 1167 C
00789 1168 C
00790 1169 C
00791 1170 C
00792 1171 C
00793 1172 C
00794 1173 C
00795 1174 C
00796 1175 C
00797 1176 C
00798 1177 C
00799 1178 C
00800 1179 C
00801 1180 C
00802 1181 C
00803 1182 C
00804 1183 C
00805 1184 C
00806 1185 C
00807 1186 C
00808 1187 C
00809 1188 C
00810 1189 C
00811 1190 C
00812 1191 C
00813 1192 C
00814 1193 C
00815 1194 C
00816 1195 C
00817 1196 C
00818 1197 C
00819 1198 C
00820 1199 C
00821 1200 C
00822 1201 C
00823 1202 C
00824 1203 C
00825 1204 C
00826 1205 C
00827 1206 C
00828 1207 C
00829 1208 C
00830 1209 C
00831 1210 C
00832 1211 C
00833 1212 C
00834 1213 C
00835 1214 C
00836 1215 C
00837 1216 C
00838 1217 C
00839 1218 C
00840 1219 C
00841 1220 C
00842 1221 C
00843 1222 C
00844 1223 C
00845 1224 C
00846 1225 C
00847 1226 C
00848 1227 C
00849 1228 C
00850 1229 C
00851 1230 C
00852 1231 C
00853 1232 C
00854 1233 C
00855 1234 C
00856 1235 C
00857 1236 C
00858 1237 C
00859 1238 C
00860 1239 C
00861 1240 C
00862 1241 C
00863 1242 C
00864 1243 C
00865 1244 C
00866 1245 C
00867 1246 C
00868 1247 C
00869 1248 C
00870 1249 C
00871 1250 C
00872 1251 C
00873 1252 C
00874 1253 C
00875 1254 C
00876 1255 C
00877 1256 C
00878 1257 C
00879 1258 C
00880 1259 C
00881 1260 C
00882 1261 C
00883 1262 C
00884 1263 C
00885 1264 C
00886 1265 C
00887 1266 C
00888 1267 C
00889 1268 C
00890 1269 C
00891 1270 C
00892 1271 C
00893 1272 C
00894 1273 C
00895 1274 C
00896 1275 C
00897 1276 C
00898 1277 C
00899 1278 C
00900 1279 C
00901 1280 C
00902 1281 C
00903 1282 C
00904 1283 C
00905 1284 C
00906 1285 C
00907 1286 C
00908 1287 C
00909 1288 C
00910 1289 C
00911 1290 C
00912 1291 C
00913 1292 C
00914 1293 C
00915 1294 C
00916 1295 C
00917 1296 C
00918 1297 C
00919 1298 C
00920 1299 C
00921 1300 C
00922 1301 C
00923 1302 C
00924 1303 C
00925 1304 C
00926 1305 C
00927 1306 C
00928 1307 C
00929 1308 C
00930 1309 C
00931 1310 C
00932 1311 C
00933 1312 C
00934 1313 C
00935 1314 C
00936 1315 C
00937 1316 C
00938 1317 C
00939 1318 C
00940 1319 C
00941 1320 C
00942 1321 C
00943 1322 C
00944 1323 C
00945 1324 C
00946 1325 C
00947 1326 C
00948 1327 C
00949 1328 C
00950 1329 C
00951 1330 C
00952 1331 C
00953 1332 C
00954 1333 C
00955 1334 C
00956 1335 C
00957 1336 C
00958 1337 C
00959 1338 C
00960 1339 C
00961 1340 C
00962 1341 C
00963 1342 C
00964 1343 C
00965 1344 C
00966 1345 C
00967 1346 C
00968 1347 C
00969 1348 C
00970 1349 C
00971 1350 C
00972 1351 C
00973 1352 C
00974 1353 C
00975 1354 C
00976 1355 C
00977 1356 C
00978 1357 C
00979 1358 C
00980 1359 C
00981 1360 C
00982 1361 C
00983 1362 C
00984 1363 C
00985 1364 C
00986 1365 C
00987 1366 C
00988 1367 C
00989 1368 C
00990 1369 C
00991 1370 C
00992 1371 C
00993 1372 C
00994 1373 C
00995 1374 C
00996 1375 C
00997 1376 C
00998 1377 C
00999 1378 C
01000 1379 C

```

Line	Code	Text
0000	0000	Y=TS+M4
0001	0000	DO 310 I=1,NV
0002	0000	Z(1)=M4*(2*(1)+D(1))
0003	0000	C=0.000
0004	0000	C=0.000
0005	0000	C=0.000
0006	0000	C=0.000
0007	0000	C=0.000
0008	0000	C=0.000
0009	0000	C=0.000
0010	0000	C=0.000
0011	0000	C=0.000
0012	0000	C=0.000
0013	0000	C=0.000
0014	0000	C=0.000
0015	0000	C=0.000
0016	0000	C=0.000
0017	0000	C=0.000
0018	0000	C=0.000
0019	0000	C=0.000
0020	0000	C=0.000
0021	0000	C=0.000
0022	0000	C=0.000
0023	0000	C=0.000
0024	0000	C=0.000
0025	0000	C=0.000
0026	0000	C=0.000
0027	0000	C=0.000
0028	0000	C=0.000
0029	0000	C=0.000
0030	0000	C=0.000
0031	0000	C=0.000
0032	0000	C=0.000
0033	0000	C=0.000
0034	0000	C=0.000
0035	0000	C=0.000
0036	0000	C=0.000
0037	0000	C=0.000
0038	0000	C=0.000
0039	0000	C=0.000
0040	0000	C=0.000
0041	0000	C=0.000
0042	0000	C=0.000
0043	0000	C=0.000
0044	0000	C=0.000
0045	0000	C=0.000
0046	0000	C=0.000
0047	0000	C=0.000
0048	0000	C=0.000
0049	0000	C=0.000
0050	0000	C=0.000
0051	0000	C=0.000
0052	0000	C=0.000
0053	0000	C=0.000
0054	0000	C=0.000
0055	0000	C=0.000
0056	0000	C=0.000
0057	0000	C=0.000
0058	0000	C=0.000
0059	0000	C=0.000
0060	0000	C=0.000
0061	0000	C=0.000
0062	0000	C=0.000
0063	0000	C=0.000
0064	0000	C=0.000
0065	0000	C=0.000
0066	0000	C=0.000
0067	0000	C=0.000
0068	0000	C=0.000
0069	0000	C=0.000
0070	0000	C=0.000
0071	0000	C=0.000
0072	0000	C=0.000
0073	0000	C=0.000
0074	0000	C=0.000
0075	0000	C=0.000
0076	0000	C=0.000
0077	0000	C=0.000
0078	0000	C=0.000
0079	0000	C=0.000
0080	0000	C=0.000
0081	0000	C=0.000
0082	0000	C=0.000
0083	0000	C=0.000
0084	0000	C=0.000
0085	0000	C=0.000
0086	0000	C=0.000
0087	0000	C=0.000
0088	0000	C=0.000
0089	0000	C=0.000
0090	0000	C=0.000
0091	0000	C=0.000
0092	0000	C=0.000
0093	0000	C=0.000
0094	0000	C=0.000
0095	0000	C=0.000
0096	0000	C=0.000
0097	0000	C=0.000
0098	0000	C=0.000
0099	0000	C=0.000
0100	0000	C=0.000

```

00361 1749 C QDQ ABS(AMIN(LAMS,ABS(TB)))
00362 1750 M=SIGN(MH,TR)
00363 1760 M=M-225*M
00364 1770 M=60*M/6.
00365 1780 N12=N4/2.
00366 1790 Y=T5+M4
00367 1800 CALL FCN
00370 1810 DO 402 I=1,NV
00371 1820 X(I)=Z(I)*DS(I)+M*DS(I)
00374 1830 T=I*N4
00376 1840 CALL FCN
00377 1850 DO 404 I=1,NV
00380 1860 Z(I)=Z(I)+2.*DS(I)
00403 1870 Y=I*N4
00404 1880 X(I)=Z(I)*DS(I)+M*DS(I)
00406 1890 T=I*N4
00407 1900 CALL FCN
00410 1910 M=400.*I/NV
00413 1920 Y=I*(1.-22(I)+M*DS(I))
00415 1930 T=I*N4
00416 1940 CALL FCN
00417 1950 QDQ=500.*I/NV
00422 1960 Z(I)=X(I)*Z(I)+DS(I)
00423 1970 X(I)=Y*(1.-22(I)+M*DS(I))
00423 1980 C .....
00423 1990 C
00423 2000 C ERROR CHECKING SEQUENCE
00423 2010 C IN THIS SECTION THE SIZE STANDARD IS UPDATED,THE ERRORS ARE
00423 2020 C COMPUTED,THE WORST ERROR IS COMPUTED,AND DECISIONS ARE MADE
00423 2030 C AS TO HOW TO PROCEED.
00423 2040 C
00425 2050 EQP=LEARN*DA
00426 2060 IF(INDKTR.EQ.1) RETURN 1
00430 2070 RECIP=LJ/AH
00431 2080 DO 510 I=1,NV
00434 2090 CHNG(I)=AHAXI(ABS(Z(I)),ABS(Z(I)))
00435 2100 DIFF(I)=(Z(I)-Z(I))/IS.
00436 2110 IF(CHNG(I)) 504,504,504
00441 2120 504 RERR(I)=G.
00442 2130 DHIST(I)=G.
00443 2140 GO TO 510
00444 2150 506 DHIST(I)=AHAXI(CHNG(I),RECIP*DMS(DHIST(I)))
00444 2160 C***
00444 2170 C SIZE STANDARD
00445 2180 ERNSTO(I)=AHAXI(DHIST(I)+MH,MH*SY(I))
00445 2190 C***
00445 2200 C ERROR FOR EACH EQUATION
00446 2210 RERR(I)=ABS(DIFF(I))/(ERNSTO(I)*RERR(I))
00446 2220 C***
00446 2230 C WORST ERROR FOR ALL EQUATIONS
00447 2240 TERM=AHAXI(RERR(I),TERM)
00450 2250 SIO CONTINUE
00450 2260 C***
00450 2270 C
00450 2280 C***
00450 2290 C NOW PROCESS ITEST TO DECIDE WHAT TO DO WITH THIS
00450 2300 C INTEGRATION CYCLE
00450 2310 C

```

```

00452 2320 IF(TERR.GT.10.) GO TO 514
00453 2330 IF(ABS(TN)-AH) 512,512,513
00454 2340 512 RETN = TRUE.
00455 2350 GO TO 600
00456 2360 513 IF(TERR.GT.1.) GO TO 520
00457 2370 IF(REJECT) GO TO 600
00458 2380 AHS=AMINI(2.0,(1.0-C*TERR)/(A0+TERR))0AH
00459 2390 GO TO 600
00460 2400 514 REJECT = TRUE.
00461 2410 IREJEC = IREJEC + 1
00462 2420 IF(AHS.GT.AHMIN) GO TO 518
00463 2430 NFALL = NFALL + 1
00464 2440 IF(NFALL.GT.1) GO TO 516
00465 2450 YF=YS
00466 2460 516 YF=YS
00467 2470 GO TO 700
00468 2480 518 AHS=AMAXI(AHMIN,AMAXI(.5*(TERR+A0)/(TERR+C))0AH)
00469 2490 GO TO INTEG.(300,400)
00470 2500 520 AHS=AMAXI(AHMIN,(TERR+A0)/(TERR+C))0AH
00471 2510 C0000
00472 2520 C
00473 2530 C
00474 2540 C
00475 2550 C
00476 2560 C
00477 2570 C
00478 2580 600 REJECT = FALSE.
00479 2590 610 DO 420 1=1,NV
00480 2600 2(1)=2(1)+DIFF(1)
00481 2610 XD(1)=XD(1)+DBLE(X(1))
00482 2620 X(1)=SNGL(XD(1))
00483 2630 X(1)=X(1)
00484 2640 620 XHIST(1)=AMAXI(ABS(X(1)),NRMCXHIST(1))
00485 2650 TD=TD+DBLE(XHIST(1))
00486 2660 Y=SNGL(TD)
00487 2670 TS=7
00488 2680 GO TO UPOS.(622,624)
00489 2690 622 IND = 1
00490 2700 CALL FCN
00491 2710 IND = 0
00492 2720 624 DO 430 1=1,NV
00493 2730 630 DS(1)=D(1)
00494 2740 NSTE=NSTEP+1
00495 2750 IF(10DIAG.EQ.0) GO TO 636
00496 2760 IF(NSTEP.LE.NAXMT) GO TO 730
00497 2770 636 IF(TP-ENDT)638,640,638
00498 2780 638 TP=ENDY
00499 2790 RETN = FALSE.
00500 2800 640 YK=TP=YS
00501 2810 IREJEC = 0
00502 2820 IF(IRETN) RETURN
00503 2830 NSTEP2 = NSTEP2 + 1
00504 2840 IF(NSTEP2.LT.NSTEP2) GO TO INTEG.(300,400)
00505 2850 IF (ABS(YS-TEST)-TEST) 710,710,644
00506 2860 644 YTESY = YS
00507 2870 NSTEP2 = 0
00508 2880 GO TO INTEG.(300,400)
00509 2890 C

```

```

00540 2900 C .....
00540 2910 C
00540 2920 C DIAGNOSTIC SECTION.
00540 2930 C THREE LEVELS OF DIAGNOSTICS ARE POSSIBLE TWO OF
00540 2940 C WHICH CAUSE AN ERROR RETURN
00540 2950 C
00540 2960 C *****
00540 2970 C
00540 2980 C
00540 2990 C 1. IF AN ERROR TEST IS NOT SATISFIED AT MINIMUM STEP:
00540 3000 C A MESSAGE IS PRINTED. THIS IS ALLOWED TO HAPPEN
00540 3010 C AT MOST NFAIL1 TIMES AT WHICH TIME
00540 3020 C THE ERROR RETURN IS MADE
00540 3030 C
00540 3040 C
00540 3050 C 700 WRITE(6,700) IS (ERRR111,111,NV)
00540 3060 C 702 FORMAT(1H0,23HERROR CHECK FAILURE AT ,E14.8,10X,23HERROR INDICATO
00540 3070 C 703 FOLLOW(11H F9.3,9F9.3)
00540 3080 C IF (NFAIL1.NE.0) GO TO 610
00540 3090 C WRITE(6,704)
00540 3100 C 704 FORMAT(1H0,51H EXCESSIVE ERROR CHECK FAILURES AT MINIMUM STEP SIZE)
00540 3110 C WRITE(6,704) IS (X111,111,NV)
00540 3120 C 706 FORMAT(1H0,26H INTEGRATION TERMINATED AT ,E14.8,
00540 3130 C 150H WITH THE FOLLOWING DEPENDENT VARIABLE EVALUATIONS, (2B14.8))
00540 3140 C WRITE(6,706) F1,F2
00540 3150 C 708 FORMAT(1H0,51H FIRST ERROR FAULTURE AT MINIMUM STEP FOR INDEP VAR =,
00540 3160 C 1E13.8/52H LAST ERROR FAILURE AT MINIMUM STEP FOR INDEP VAR =,E13.
00540 3170 C 28)
00540 3180 C RETURN 1
00540 3190 C
00540 3200 C *****
00540 3210 C
00540 3220 C 2. IF AN INTEGRATION TAKES NSTEP2 STEPS IN A SMALL
00540 3230 C FRACTION OF THE CURRENT PRINT INTERVAL IT IS
00540 3240 C THE VARIABLE SET TO THIS FRACTION) IT IS LIKELY
00540 3250 C THAT EXCESSIVE COMPUTER TIME WILL BE CONSUMED
00540 3260 C BEFORE THE PROBLEM IS COMPLETED. THEREFORE
00540 3270 C THE ERROR RETURN IS MADE
00540 3280 C
00540 3290 C
00540 3300 C 710 WRITE (6,712) NSTEP2,ITEST,IS
00540 3310 C 712 FORMAT(1H0,31H INTEGRATION PROCEDURE REQUIRED ,13.6H STEPS/1H0,27H
00540 3320 C FROM INDEPENDENT VARIABLE =,E14.8/28H TO INDEPENDENT VARIABLE =,E
00540 3330 C 214.8/1H0,40H COMPUTATION CONSIDERED PROHIBITIVELY SLOW)
00540 3340 C WRITE(6,706) IS (X111,111,NV)
00540 3350 C IF (NFAIL1.NE.0) WRITE (6,706) F1,F2
00540 3360 C RETURN 1
00540 3370 C
00540 3380 C *****
00540 3390 C
00540 3400 C 3. AS A DEBUGGING AID, A DIAGNOSTIC MAY BE PRINTED
00540 3410 C EACH STEP, HOWEVER, NO MORE THAN MAXN OF THESE
00540 3420 C CAN BE PRINTED IN EACH PRINT INTERVAL. THIS IS TO
00540 3430 C PREVENT THE INADVERTENT GENERATION OF
00540 3440 C EXCESSIVE OUTPUT.
00540 3450 C
00540 3460 C
00540 3470 C 730 IF (IDIAS.EQ.1) GO TO 750
00540 3480 C WRITE(6,742) NSTEP, IREJCAT, S, H, TERR, (ERRR(1),111,NV)
00540 3490 C 742 FORMAT(1H 23H,5E14.8,10X,2,11H 10X,15F8.2))
00540 3500 C GO TO 636
00540 3510 C 750 NSORT =IND(15,NV)
00540 3520 C DO 770 I=1,NSORT
00540 3530 C SORT = 0.
00540 3540 C
00540 3550 C

```



```

00663 3400 DO 740 J=1,NV
00664 3401 IF (ERR(J).LT.SORT) GO TO 740
00665 3402 SORT = ERR(J)
00666 3403 K=J
00667 3404 740 CONTINUE
00668 3405 ISAVE(I)=K
00669 3406 ISAVE(I)= SORT
00670 3407 770 RERR(K) = -1
00671 3408 WRITE(6,780) RSTEP, I, RERR(K), TS, M, (PINAGL(I)), ISAVE(I), NSAVE(I),
00672 3409 J=1, NSORT)
00673 3410 780 FORMAT(1H, 219, 12E17.8, 5(1X, A1, 13.1H, 3F6.2, 1H))
00674 3411 GO TO 636
00675 3412 *****
00676 3413 C
00677 3414 END
00678 3415
00679 3416
00680 3417
00681 3418
00682 3419
00683 3420
00684 3421
00685 3422
00686 3423
00687 3424
00688 3425
00689 3426
00690 3427
00691 3428
00692 3429
00693 3430
00694 3431
00695 3432
00696 3433
00697 3434
00698 3435
00699 3436
00700 3437
00701 3438
00702 3439
00703 3440
00704 3441
00705 3442
00706 3443
00707 3444
00708 3445
00709 3446
00710 3447
00711 3448
00712 3449
00713 3450
00714 3451
00715 3452
00716 3453
00717 3454
00718 3455
00719 3456
00720 3457
00721 3458
00722 3459
00723 3460
00724 3461
00725 3462
00726 3463
00727 3464
00728 3465
00729 3466
00730 3467
00731 3468
00732 3469
00733 3470
00734 3471
00735 3472
00736 3473
00737 3474
00738 3475
00739 3476
00740 3477
00741 3478
00742 3479
00743 3480
00744 3481
00745 3482
00746 3483
00747 3484
00748 3485
00749 3486
00750 3487
00751 3488
00752 3489
00753 3490
00754 3491
00755 3492
00756 3493
00757 3494
00758 3495
00759 3496
00760 3497
00761 3498
00762 3499
00763 3500
00764 3501
00765 3502
00766 3503
00767 3504
00768 3505
00769 3506
00770 3507
00771 3508
00772 3509
00773 3510
00774 3511
00775 3512
00776 3513
00777 3514
00778 3515
00779 3516
00780 3517
00781 3518
00782 3519
00783 3520
00784 3521
00785 3522
00786 3523
00787 3524
00788 3525
00789 3526
00790 3527
00791 3528
00792 3529
00793 3530
00794 3531
00795 3532
00796 3533
00797 3534
00798 3535
00799 3536
00800 3537
00801 3538
00802 3539
00803 3540
00804 3541
00805 3542
00806 3543
00807 3544
00808 3545
00809 3546
00810 3547
00811 3548
00812 3549
00813 3550
00814 3551
00815 3552
00816 3553
00817 3554
00818 3555
00819 3556
00820 3557
00821 3558
00822 3559
00823 3560
00824 3561
00825 3562
00826 3563
00827 3564
00828 3565
00829 3566
00830 3567
00831 3568
00832 3569
00833 3570
00834 3571
00835 3572
00836 3573
00837 3574
00838 3575
00839 3576
00840 3577
00841 3578
00842 3579
00843 3580
00844 3581
00845 3582
00846 3583
00847 3584
00848 3585
00849 3586
00850 3587
00851 3588
00852 3589
00853 3590
00854 3591
00855 3592
00856 3593
00857 3594
00858 3595
00859 3596
00860 3597
00861 3598
00862 3599
00863 3600
00864 3601
00865 3602
00866 3603
00867 3604
00868 3605
00869 3606
00870 3607
00871 3608
00872 3609
00873 3610
00874 3611
00875 3612
00876 3613
00877 3614
00878 3615
00879 3616
00880 3617
00881 3618
00882 3619
00883 3620
00884 3621
00885 3622
00886 3623
00887 3624
00888 3625
00889 3626
00890 3627
00891 3628
00892 3629
00893 3630
00894 3631
00895 3632
00896 3633
00897 3634
00898 3635
00899 3636
00900 3637
00901 3638
00902 3639
00903 3640
00904 3641
00905 3642
00906 3643
00907 3644
00908 3645
00909 3646
00910 3647
00911 3648
00912 3649
00913 3650
00914 3651
00915 3652
00916 3653
00917 3654
00918 3655
00919 3656
00920 3657
00921 3658
00922 3659
00923 3660
00924 3661
00925 3662
00926 3663
00927 3664
00928 3665
00929 3666
00930 3667
00931 3668
00932 3669
00933 3670
00934 3671
00935 3672
00936 3673
00937 3674
00938 3675
00939 3676
00940 3677
00941 3678
00942 3679
00943 3680
00944 3681
00945 3682
00946 3683
00947 3684
00948 3685
00949 3686
00950 3687
00951 3688
00952 3689
00953 3690
00954 3691
00955 3692
00956 3693
00957 3694
00958 3695
00959 3696
00960 3697
00961 3698
00962 3699
00963 3700
00964 3701
00965 3702
00966 3703
00967 3704
00968 3705
00969 3706
00970 3707
00971 3708
00972 3709
00973 3710
00974 3711
00975 3712
00976 3713
00977 3714
00978 3715
00979 3716
00980 3717
00981 3718
00982 3719
00983 3720
00984 3721
00985 3722
00986 3723
00987 3724
00988 3725
00989 3726
00990 3727
00991 3728
00992 3729
00993 3730
00994 3731
00995 3732
00996 3733
00997 3734
00998 3735
00999 3736

```

END OF COMPILATION! NO DIAGNOSTICS.

MARKS SYMBOLIC

MARKS CODE RELOCATABLE

05 SEP 73 141211Z 0 01453240 14 361 (DELETED)  
 05 SEP 73 141211Z 1 01505136 36 97 (DELETED)  
 05 SEP 73 141211Z 0 01545202 14 97

29 JUN 74 5135132-499

9 FOR OUTPUT OUTPUT  
UNIVAC 1100 FORTRAN 7 EXEC 11 LEVEL 25A -EXECCH LEVEL F12R1001010A  
THIS COMPILATION WAS DONE ON 29 JUN 74 AT 0515132

SUBROUTINE OUTPUT ENTRY POINT 000451

STORAGE USED: CODE(1) 000471 DATA(0) 0002431 BLANK COMMON(2) 000000

COMMON BLOCKS:

0003 MKYS1 000245  
0004 EXCFND 000004  
0005 ACVAC 000030  
0006 ACTEND 000022  
0007 ACVA 000014  
0010 FORCES 000014  
0011 NTRTC 000004  
0012 NTRTD 000004  
0013 ACSTRD 000004  
0014 FLTD 001251

EXTERNAL REFERENCES (BLOCK, NAME)

0015 MROUS  
0016 NIQ25  
0017 NERR25  
0020 NIQ18  
0021 MROUS  
0022 NERR3

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000077	10L	0001	000502	100L	0001	000537	120L	0001	000543	130L	0001	00063	1426
0001	000024	150L	0001	000127	1646	0001	000161	1786	0001	000114	20L	0001	000176	2046
0001	000203	2106	0001	000210	2146	0001	000226	2256	0001	000233	2316	0001	000240	2356
0001	000352	2456	0001	000372	2556	0001	000341	3106	0001	000304	2356	0001	000311	2716
0001	000157	30L	0001	000327	3026	0001	000341	3106	0001	000443	3346	0001	000504	3436
0001	000320	3526	0001	000525	3546	0001	000532	3626	0001	000344	3346	0001	000551	3756
0001	000564	4016	0001	000565	4076	0001	000601	4146	0001	000406	4226	0001	000613	4246
0001	000520	4326	0001	000320	50L	0001	000250	60L	0001	000316	70L	0001	000345	80L
0001	000347	70L	0000	000330	401F	0000	000332	902F	0000	000020	903F	0000	000117	904F
0000	000154	905F	0000	000163	906F	0000	000171	907F	0007	R	000000	AL	0007	R
0005	000006	CA	0005	R	000000	CAL	0012	000001	EXFRQ	0004	000000	FILL	0013	000000
0010	000000	FAM	0010	R	000004	FP	0012	000000	FRMNY	0000	I	000025	I	0012
0000	I	000027	160	0012	000005	INDKTR	0000	000332	INJPS	0011	I	000305	I	000004
0000	I	000024	K	0000	I	000024	LINES	0013	R	000005	LO	0000	I	000000
0014	I	000000	NPLTS	0004	R	000014	OMEGAE	0011	R	000002	OUTFRQ	0005	R	000001
0003	R	000000	TIME	0012	R	000003	TLOT	0014	R	000001	TPLT	0012	R	000002
0003	R	000001	X	0003	R	000133	XDOT	0004	R	000000	XIO	0000	R	000016

00101 10 SUBROUTINE OUTPUT

```

00103 20 COMMON /NRKVS1/ TIME,X(90),ROOF(90)
00104 30 COMMON /FRCFND/ XIQ(6)
00105 40 COMMON /ACVAC/ CAL(6),CA(12),TDIC(6)
00106 50 COMMON /ACTEND/ FILL(12),OMEGA(6)
00107 60 COMMON /ACVLA/ AL(6),AV(6)
00108 70 COMMON /FORCES/ FMH(6),FPI(6)
00109 80 COMMON /INTERC/ TSTART,TEND,OUTFRQ(2),IPROPT,IPLOTT
00110 90 COMMON /INTGRD/ FRMCTA,EXFRO,TPRINT,YPLOTT,IPFIRST,INDSTR
00111 00 COMMON /ACSTRD/ FILL(15),LO
00112 10 COMMON /PLOTD/ MPLTS,IPLT (1000)
00113 10 DIMENSION N(4),M(4),XP(16),XP2(6)
00114 120 REAL LO
00115 130 DATA LINES/60/
00116 140
00117 150 901 FORMAT(11)
00118 160 902 FORMAT(1/ 55X 'TIME 1' IPE12.6, ' SEC')
00119 170 903 FORMAT(1/ 4X 'INCREMENTAL ANGULAR MOTIONS'
00120 180 1 / 4X 'INCREMENTAL VELOCITIES OF TABLE C.G.'
00121 190 2 / 4X 'INCREMENTAL ANGULAR MOTIONS'
00122 200 3 / 4X 'EULER ANGLE RATES'
00123 210 4 / 4X 'TABLE POSITION ERROR (ACTUAL-COMMAND)'
00124 220 904 FORMAT(1/ 4X 'BENDING FREQUENCIES AT CYLINDER ROD SEAL'
00125 230 1 / 4X 'LATERAL ELASTIC DISPLACEMENTS AT CYLINDER'
00126 240 2 / 4X 'ROD SEALS'
00127 250 3 / 4X 'LATERAL ELASTIC DISPLACEMENTS AT CYLINDER'
00128 260 4 / 4X 'ROD SEALS'
00129 270 905 FORMAT(1/ 4X 'DERIVATIVE ARRAY (TSB,AG12.6)'
00130 280 906 FORMAT(1/ 4X 'VARIABLE ARRAY (TSB,AG12.6)'
00131 290 907 FORMAT(1/ 4X 'ACTUATOR STROKES'
00132 300 1 / 4X 'ACTUATOR VELOCITIES'
00133 310 2 / 4X 'ACTUATOR POSITION ERROR (ACTUAL-COMMAND)'
00134 320 3 / 4X 'NET FORCES ON ACTUATOR PISTONS'
00135 330 IF (IPROPT.LE.0) OR (TIME.LT.TPRINT) GO TO 90
00136 340 TPRINT = TIME-OUTFRQ(1)
00137 350 IF (TPRINT.GT.TEND) TPRINT = TEND
00138 360 N(1) = IPROPT/1000
00139 370 N(2) = (IPROPT-N(1))*1000/100
00140 380 N(3) = (IPROPT-N(1))*1000-N(2)*100/10
00141 390 N(4) = IPROPT-N(1)*1000-N(2)*100-N(3)*10
00142 400 DO 10 I=1,4
00143 410 IF (N(I).LT.4) GO TO 10
00144 420 WRITE(6,901)
00145 430 GO TO 20
00146 440 10 CONTINUE
00147 450 IF (LINES.LE.40) GO TO 20
00148 460 WRITE(6,901)
00149 470 LINES = 0
00150 480 20 CONTINUE
00151 490 WRITE(6,902) TIME
00152 500 LINES = LINES+2
00153 510 DO 80 K=1,4
00154 520 100 = N(K)
00155 530 IF (100.LE.0) OR (100.GT.4) GO TO 80
00156 540 GO TO (30,50,60,70),100
00157 550 C DATA SET NO. 1 TABLE RESPONSE DATA
00158 560 C
00159 570 30 DO 40 I=1,6
00160 580 XP1(I) = X(10+I)*X10(1)
00161 590

```

85

NO DIAGNOSTICS.

END OF COMPILATION!

OUTPUT SYMBOLIC  
OUTPUT CODE RELOCATABLE

05 SEP 73 14121112 0 01423432 14 116 (DELETED)  
08 SEP 73 14121112 1 01446762 40 1 (DELETED)  
0 01467056 14 54

29 JUN 74

5:55:39.66

FOR PLOTTER, PLOTTER

UNIVAC 1100 FORTRAN V EXEC 11 LEVEL 25A - (EXEC LEVEL F120100101)

THIS COMPILATION WAS DONE ON 29 JUN 74 AT 05:35:34

SUBROUTINE PLOTTER ENTRY POINT 000722

STORAGE USED: CODE(1) 001131 DATA(1) 0651161 BLANK COMMON(2) 000000

COMMON BLOCKS:

0003 PLOT 000001

0004 NTR 200004

EXTERNAL REFERENCES (BLOCK, NAME)

0005 PLT3

0006 PRINT

0007 NTR

0010 NTR

0011 NTR

0012 NTR

0013 NTR

0014 NTR

0015 NTR

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000420	100L	0001	000423	110L	0001	000052	131G	0001	000532	140L	0001	000141	142G
0001	000150	150G	0001	000417	140L	0001	000625	141L	0001	000201	142G	0001	000633	142L
0001	000441	143L	0001	000416	143L	0001	000454	146L	0001	000707	147L	0001	000737	170L
0001	000214	172G	0001	000745	180L	0001	000242	203G	0001	000266	213G	0001	000307	217G
0001	000310	222G	0001	000425	185G	0001	000137	270G	0001	000445	273G	0001	000174	30L
0001	000535	315G	0001	000543	321G	0001	000567	375G	0001	000570	330G	0001	000240	50L
0001	000244	70L	0001	000341	90L	0001	000434	901F	0001	000472	902F	0001	000460	903F
0001	000465	904F	0001	000473	975F	0001	000470	904F	0001	0004715	907F	0001	0004722	908F
0001	0004727	909F	0001	000351	91L	0001	0004740	910F	0001	000361	92L	0001	000371	93L
0001	000401	94L	0001	000411	95L	0001	000434	A	0001	0004734	B	0001	000004	BUFF
0001	0004631	DUM	0001	000400	FILL	0001	0004630	I	0001	000432	150	0001	000035	INJPS
0001	0005051	INJPS	0001	0004631	INJPS	0001	000005	IPLOPT	0001	0004633	11	0001	0004635	12
0001	0004626	J	0001	0004624	K	0001	0004634	L	0001	000000	MO	0001	0004627	N
0001	000000	NPLPTS	0001	0004625	NUM	0001	0004625	NUM	0001	000000	NPLPTS	0001	000000	NPLPTS

00101 SUBROUTINE PLOTTER

00102 COMMON / PLOT / NPLPTS

00103 COMMON / NTR / FILL(5), IPLOPT

00104 DIMENSION MO(4), BUFF(24), A(1000,24), B(1000,3)

00105 901 FORMAT( / 40X INCREMENTAL INERTIAL MOTIONS OF TABLE C.G.)

00106 902 FORMAT( / 40X INCREMENTAL ANGULAR MOTIONS OF TABLE C.G.)

00107 903 FORMAT( / 50X INERTIAL VELOCITIES)

00108 904 FORMAT( / 45X EULER ANGLE VELOCITIES)

00109 905 FORMAT( / 40X TABLE POSITION ERROR (ACTUAL-COMMANDED))

00110

00111

00112

```

00113 100 904 FORMAT(1/ 40X,ACTUATOR BENDING DATA FOR ACTUATOR NO. 13)
00114 110 902 FORMAT(1/ 52X,ACTUATOR STROKES)
00115 120 906 FORMAT(1/ 50X,ACTUATOR VELOCITIES)
00116 130 907 FORMAT(1/ 39X,ACTUATOR POSITION ERROR (ACTUAL-COMMANDED))
00117 140 909 FORMAT(1/ 45X,NET FORCES ON ACTUATOR PISTONS)
00120 150 IF(IPLPT-LE,0) RETURN
00122 160 IF(NPLPTS-GE,1000) NPLPTS = 1000
00124 170 M(11) = IPLPT/1000
00125 180 M(12) = (IPLPT-M(11)*1000)/100
00126 190 M(13) = (IPLPT-M(11)*1000-M(12)*100)/10
00127 200 M(14) = IPLPT-M(11)*1000-M(12)*100-M(13)*10
00130 210 DO 180 K=1,4
00133 220 IF(MO(K)*LE,0,OR-MO(K)*GT,3) GO TO 180
00135 230 REMIND 3
00136 240 NUM = 18
00137 250 IF(MO(K)*EQ,3) NUM = 24
00137 260 C
00137 270 C READ DATA FROM TAPE
00137 280 C
00141 290 DO 60 J=1,NPLPTS
00144 300 IF(K*EQ,1) GO TO 30
00146 310 N = K-1
00147 320 DO 20 I=1,N
00152 330 IF(MO(I)*GT,0,AND-MO(I)*LT,4) READ(3) DUM
00156 340 20 CONTINUE
00160 350 30 READ(3) (BUFF(I),I=1,NUM)
00164 360 IF(K*EQ,4) GO TO 50
00170 370 N = K+1
00171 380 DO 40 I=N,4
00174 390 IF(MO(I)*GT,0,AND-MO(I)*LT,4) READ(3) DUM
00200 400 40 CONTINUE
00202 410 50 DO 60 J=1,NUM
00205 420 60 A(J) = BUFF(J)
00210 430 IGO = MO(K)
00211 440 GO TO(70,110,140, 160
00211 450 C
00211 460 C DATA SET 1 TABLE RESPONSE DATA
00211 470 C
00212 480 70 DO 100 I=1,4
00215 490 L = 3*(I-1)
00216 500 DO 80 J=1,3
00221 510 DO 80 J=1,NPLPTS
00228 520 80 B(I,J) = A(I)+J2
00227 530 CALL PLT3(B)
00230 540 GO TO 190,91,92,93,94,95), 21
00231 550 90 WRITE(17,901)
00233 560 CALL XYZ
00234 570 GO TO 100
00235 580 91 WRITE(17,902)
00237 590 CALL ROT
00240 600 GO TO 100
00241 610 92 WRITE(17,903)
00243 620 CALL XYZ
00244 630 GO TO 100
00245 640 93 WRITE(17,904)
00247 650 CALL ROT
00250 660 GO TO 100
00251 670 94 WRITE(17,905)

```

```

00253 580 CALL XYZ
00254 590 GO TO 100
00255 700 95 1 ITE(17,905)
00257 710 CALL ROT
00260 720 100 CONTINUE
00262 730 GO TO 160
00264 740
00266 750 C DATA SET 2 ACTUATOR READING DATA
00268 760 C
00269 770 110 CONTINUE
00270 780 DO 130 I=1,6
00271 790 DO 120 J=1,NPLPTS
00272 800 DC 120 I=1,3
00273 810 L = A(I,I)
00274 820 120 B(I,I) = A(I,I+1)
00275 830 CALL PLT3(8)
00276 840 WRITE(17,906) I
00277 850 CALL PRINT(12,130,0,16,9,FREQUENCYCV)
00278 860 CALL PRINT(12,420,0,16,14,Y DISPLACEMENT)
00279 870 CALL PRINT(12,750,0,16,14,Z DISPLACEMENT)
00280 880 130 CONTINUE
00281 890 GO TO 160
00282 900 C DATA SET 3 ACTUATOR RESPONSES
00283 910 C
00284 920 C
00285 930 140 CONTINUE
00286 940 DO 170 I=1,4
00287 950 L = A(I,I)
00288 960 DO 170 I=1,2
00289 970 N = 3*(I2-1)
00290 980 DO 150 J=1,3
00291 990 150 B(I,J) = A(I,I+N*J)
00292 1000 CALL PLT3(8)
00293 1010 GO TO (160,161,162,163), I
00294 1020 160 WRITE(17,907)
00295 1030 GO TO 165
00296 1040 161 WRITE(17,908)
00297 1050 GO TO 165
00298 1060 162 WRITE(17,909)
00299 1070 GO TO 165
00300 1080 163 WRITE(17,910)
00301 1090 165 CONTINUE
00302 1100 GO TO (166,167), I2
00303 1110 166 CALL PRINT(12,210,0,16,10,I)
00304 1120 CALL PRINT(12,520,0,16,11,I2)
00305 1130 167 CALL PRINT(12,860,0,16,11,I3)
00306 1140 GO TO 170
00307 1150 167 CALL PRINT(12,210,0,16,11,I4)
00308 1160 CALL PRINT(12,530,0,16,11,I5)
00309 1170 CALL PRINT(12,860,0,16,11,I6)
00310 1180 170 CONTINUE
00311 1190 RETURN
00312 1200 SUBROUTINE XYZ
00313 1210 CALL PRINT(12,210,0,16,11,I)
00314 1220 CALL PRINT(12,530,0,16,11,I2)
00315 1230 CALL PRINT(12,860,0,16,11,I3)
00316 1240
00317 1250

```



00377 1240 RETURN  
 00400 1270 SUBROUTINE POT  
 00403 1280 CALL PRINT(12,160,0,16,5,SYNTHETIC)  
 00404 1290 CALL PRINT(12,500,0,16,3,9514)  
 00405 1300 CALL PRINT(12,830,0,16,3,9514)  
 00406 1310 RETURN  
 00407 1320 END

END OF COMPILATION: NO DIAGNOSTICS

PLOTTER CODE SYMBOLIC  
 PLOTTER CODE RELOCATABLE

15 AUG 73 15:40:51 0 01422700 14 132 (DELETED)  
 15 AUG 73 15:41:5 1 0142370 26 1 (DELETED)  
 0 01424434 14 77

29 JUN 74 5135137.131

FOR PLT3,PLT3  
UNIVAC 1100 FORTRAN V EXEC 11 LEVEL 23A -CHECKED LEVEL PLT301001001  
THIS COMPILATION WAS DONE ON 29 JUN 74 AT 05135137

SUBROUTINE PLT3 ENTRY POINT 000163

STORAGE USED: CODE(1) 0001751 DATA(0) 0000571 BLANK COMMON(2) 000000

COMMON BLOCKS:

0003 PLOTD 001751

EXTERNAL REFERENCES (BLOCK, NAME)

0004 FILMAY  
0005 GROSET  
0006 GRID  
0007 PLOTIV  
0010 PRINT  
0011 NERR33

STORAGE ASSIGNMENT (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000023 1154 0001 000043 1324 0000 000012 AMAX 0000 000006 MISC  
0002 000014 1 0000 000000 1800 0000 000035 INPS 0000 000011 K 0003 000000 NPLPTS  
0003 000001 12107

```

00101 10 SUBROUTINE PLT3(A)
00102 20 DIMENSION A(1000),I(1000),J(1000),K(1000),L(1000),M(1000),N(1000),O(1000),P(1000),Q(1000),R(1000),S(1000),T(1000),U(1000),V(1000),W(1000),X(1000),Y(1000),Z(1000),AA(1000),AB(1000),AC(1000),AD(1000),AE(1000),AF(1000),AG(1000),AH(1000),AI(1000),AJ(1000),AK(1000),AL(1000),AM(1000),AN(1000),AO(1000),AP(1000),AQ(1000),AR(1000),AS(1000),AT(1000),AU(1000),AV(1000),AW(1000),AX(1000),AY(1000),AZ(1000),BA(1000),BB(1000),BC(1000),BD(1000),BE(1000),BF(1000),BG(1000),BH(1000),BI(1000),BJ(1000),BK(1000),BL(1000),BM(1000),BN(1000),BO(1000),BP(1000),BQ(1000),BR(1000),BS(1000),BT(1000),BU(1000),BV(1000),BW(1000),BX(1000),BY(1000),BZ(1000),CA(1000),CB(1000),CC(1000),CD(1000),CE(1000),CF(1000),CG(1000),CH(1000),CI(1000),CJ(1000),CK(1000),CL(1000),CM(1000),CN(1000),CO(1000),CP(1000),CQ(1000),CR(1000),CS(1000),CT(1000),CU(1000),CV(1000),CW(1000),CX(1000),CY(1000),CZ(1000),DA(1000),DB(1000),DC(1000),DD(1000),DE(1000),DF(1000),DG(1000),DH(1000),DI(1000),DJ(1000),DK(1000),DL(1000),DM(1000),DN(1000),DO(1000),DP(1000),DQ(1000),DR(1000),DS(1000),DT(1000),DU(1000),DV(1000),DW(1000),DX(1000),DY(1000),DZ(1000),EA(1000),EB(1000),EC(1000),ED(1000),EE(1000),EF(1000),EG(1000),EH(1000),EI(1000),EJ(1000),EK(1000),EL(1000),EM(1000),EN(1000),EO(1000),EP(1000),EQ(1000),ER(1000),ES(1000),ET(1000),EU(1000),EV(1000),EW(1000),EX(1000),EY(1000),EZ(1000),FA(1000),FB(1000),FC(1000),FD(1000),FE(1000),FF(1000),FG(1000),FH(1000),FI(1000),FJ(1000),FK(1000),FL(1000),FM(1000),FN(1000),FO(1000),FP(1000),FQ(1000),FR(1000),FS(1000),FT(1000),FU(1000),FV(1000),FW(1000),FX(1000),FY(1000),FZ(1000),GA(1000),GB(1000),GC(1000),GD(1000),GE(1000),GF(1000),GG(1000),GH(1000),GI(1000),GJ(1000),GK(1000),GL(1000),GM(1000),GN(1000),GO(1000),GP(1000),GQ(1000),GR(1000),GS(1000),GT(1000),GU(1000),GV(1000),GW(1000),GX(1000),GY(1000),GZ(1000),HA(1000),HB(1000),HC(1000),HD(1000),HE(1000),HF(1000),HG(1000),HH(1000),HI(1000),HJ(1000),HK(1000),HL(1000),HM(1000),HN(1000),HO(1000),HP(1000),HQ(1000),HR(1000),HS(1000),HT(1000),HU(1000),HV(1000),HW(1000),HX(1000),HY(1000),HZ(1000),IA(1000),IB(1000),IC(1000),ID(1000),IE(1000),IF(1000),IG(1000),IH(1000),II(1000),IJ(1000),IK(1000),IL(1000),IM(1000),IN(1000),IO(1000),IP(1000),IQ(1000),IR(1000),IS(1000),IT(1000),IU(1000),IV(1000),IW(1000),IX(1000),IY(1000),IZ(1000),JA(1000),JB(1000),JC(1000),JD(1000),JE(1000),JF(1000),JG(1000),JH(1000),JI(1000),JJ(1000),JK(1000),JL(1000),JM(1000),JN(1000),JO(1000),JP(1000),JQ(1000),JR(1000),JS(1000),JT(1000),JU(1000),JV(1000),JW(1000),JX(1000),JY(1000),JZ(1000),KA(1000),KB(1000),KC(1000),KD(1000),KE(1000),KF(1000),KG(1000),KH(1000),KI(1000),KJ(1000),KL(1000),KM(1000),KN(1000),KO(1000),KP(1000),KQ(1000),KR(1000),KS(1000),KT(1000),KU(1000),KV(1000),KW(1000),KX(1000),KY(1000),KZ(1000),LA(1000),LB(1000),LC(1000),LD(1000),LE(1000),LF(1000),LG(1000),LH(1000),LI(1000),LJ(1000),LK(1000),LL(1000),LM(1000),LN(1000),LO(1000),LP(1000),LQ(1000),LR(1000),LS(1000),LT(1000),LU(1000),LV(1000),LW(1000),LX(1000),LY(1000),LZ(1000),MA(1000),MB(1000),MC(1000),MD(1000),ME(1000),MF(1000),MG(1000),MH(1000),MI(1000),MJ(1000),MK(1000),ML(1000),MM(1000),MN(1000),MO(1000),MP(1000),MQ(1000),MR(1000),MS(1000),MT(1000),MU(1000),MV(1000),MW(1000),MX(1000),MY(1000),MZ(1000),NA(1000),NB(1000),NC(1000),ND(1000),NE(1000),NF(1000),NG(1000),NH(1000),NI(1000),NJ(1000),NK(1000),NL(1000),NM(1000),NO(1000),NP(1000),NQ(1000),NR(1000),NS(1000),NT(1000),NU(1000),NV(1000),NW(1000),NX(1000),NY(1000),NZ(1000),OA(1000),OB(1000),OC(1000),OD(1000),OE(1000),OF(1000),OG(1000),OH(1000),OI(1000),OJ(1000),OK(1000),OL(1000),OM(1000),ON(1000),OO(1000),OP(1000),OQ(1000),OR(1000),OS(1000),OT(1000),OU(1000),OV(1000),OW(1000),OX(1000),OY(1000),OZ(1000),PA(1000),PB(1000),PC(1000),PD(1000),PE(1000),PF(1000),PG(1000),PH(1000),PI(1000),PJ(1000),PK(1000),PL(1000),PM(1000),PN(1000),PO(1000),PP(1000),PQ(1000),PR(1000),PS(1000),PT(1000),PU(1000),PV(1000),PW(1000),PX(1000),PY(1000),PZ(1000),QA(1000),QB(1000),QC(1000),QD(1000),QE(1000),QF(1000),QG(1000),QH(1000),QI(1000),QJ(1000),QK(1000),QL(1000),QM(1000),QN(1000),QO(1000),QP(1000),QQ(1000),QR(1000),QS(1000),QT(1000),QU(1000),QV(1000),QW(1000),QX(1000),QY(1000),QZ(1000),RA(1000),RB(1000),RC(1000),RD(1000),RE(1000),RF(1000),RG(1000),RH(1000),RI(1000),RJ(1000),RK(1000),RL(1000),RM(1000),RN(1000),RO(1000),RP(1000),RQ(1000),RR(1000),RS(1000),RT(1000),RU(1000),RV(1000),RW(1000),RX(1000),RY(1000),RZ(1000),SA(1000),SB(1000),SC(1000),SD(1000),SE(1000),SF(1000),SG(1000),SH(1000),SI(1000),SJ(1000),SK(1000),SL(1000),SM(1000),SN(1000),SO(1000),SP(1000),SQ(1000),SR(1000),SS(1000),ST(1000),SU(1000),SV(1000),SW(1000),SX(1000),SY(1000),SZ(1000),TA(1000),TB(1000),TC(1000),TD(1000),TE(1000),TF(1000),TG(1000),TH(1000),TI(1000),TJ(1000),TK(1000),TL(1000),TM(1000),TN(1000),TO(1000),TP(1000),TQ(1000),TR(1000),TS(1000),TT(1000),TU(1000),TV(1000),TW(1000),TX(1000),TY(1000),TZ(1000),UA(1000),UB(1000),UC(1000),UD(1000),UE(1000),UF(1000),UG(1000),UH(1000),UI(1000),UJ(1000),UK(1000),UL(1000),UM(1000),UN(1000),UO(1000),UP(1000),UQ(1000),UR(1000),US(1000),UT(1000),UU(1000),UV(1000),UW(1000),UX(1000),UY(1000),UZ(1000),VA(1000),VB(1000),VC(1000),VD(1000),VE(1000),VF(1000),VG(1000),VH(1000),VI(1000),VJ(1000),VK(1000),VL(1000),VM(1000),VN(1000),VO(1000),VP(1000),VQ(1000),VR(1000),VS(1000),VT(1000),VU(1000),VV(1000),VW(1000),VX(1000),VY(1000),VZ(1000),WA(1000),WB(1000),WC(1000),WD(1000),WE(1000),WF(1000),WG(1000),WH(1000),WI(1000),WJ(1000),WK(1000),WL(1000),WM(1000),WN(1000),WO(1000),WP(1000),WQ(1000),WR(1000),WS(1000),WT(1000),WU(1000),WV(1000),WW(1000),WX(1000),WY(1000),WZ(1000),XA(1000),XB(1000),XC(1000),XD(1000),XE(1000),XF(1000),XG(1000),XH(1000),XI(1000),XJ(1000),XK(1000),XL(1000),XM(1000),XN(1000),XO(1000),XP(1000),XQ(1000),XR(1000),XS(1000),XT(1000),XU(1000),XV(1000),XW(1000),XX(1000),XY(1000),XZ(1000),YA(1000),YB(1000),YC(1000),YD(1000),YE(1000),YF(1000),YG(1000),YH(1000),YI(1000),YJ(1000),YK(1000),YL(1000),YM(1000),YN(1000),YO(1000),YP(1000),YQ(1000),YR(1000),YS(1000),YT(1000),YU(1000),YV(1000),YW(1000),YX(1000),YY(1000),YZ(1000),ZA(1000),ZB(1000),ZC(1000),ZD(1000),ZE(1000),ZF(1000),ZG(1000),ZH(1000),ZI(1000),ZJ(1000),ZK(1000),ZL(1000),ZM(1000),ZN(1000),ZO(1000),ZP(1000),ZQ(1000),ZR(1000),ZS(1000),ZT(1000),ZU(1000),ZV(1000),ZW(1000),ZX(1000),ZY(1000),ZZ(1000)
00103 30 INTEGER NITE
00104 40 COMMON / PLOTD / NPLPTS,TPLOT(1000)
00105 50 DATA 1000,70,34,33,472,716,987
00106 60 DATA 1000,70,34,33,472,716,987
00107 70 DATA 1000,70,34,33,472,716,987
00108 80 DATA 1000,70,34,33,472,716,987
00109 90 DATA 1000,70,34,33,472,716,987
00110 100 DATA 1000,70,34,33,472,716,987
00111 110 DATA 1000,70,34,33,472,716,987
00112 120 DATA 1000,70,34,33,472,716,987
00113 130 DATA 1000,70,34,33,472,716,987
00114 140 DATA 1000,70,34,33,472,716,987
00115 150 DATA 1000,70,34,33,472,716,987
00116 160 DATA 1000,70,34,33,472,716,987
00117 170 DATA 1000,70,34,33,472,716,987
00118 180 DATA 1000,70,34,33,472,716,987
00119 190 DATA 1000,70,34,33,472,716,987
00120 200 DATA 1000,70,34,33,472,716,987
00121 210 DATA 1000,70,34,33,472,716,987
00122 220 DATA 1000,70,34,33,472,716,987
00123 230 DATA 1000,70,34,33,472,716,987
00124 240 DATA 1000,70,34,33,472,716,987
00125 250 DATA 1000,70,34,33,472,716,987
00126 260 DATA 1000,70,34,33,472,716,987
00127 270 DATA 1000,70,34,33,472,716,987
00128 280 DATA 1000,70,34,33,472,716,987
00129 290 DATA 1000,70,34,33,472,716,987
00130 300 DATA 1000,70,34,33,472,716,987
00131 310 DATA 1000,70,34,33,472,716,987
00132 320 DATA 1000,70,34,33,472,716,987
00133 330 DATA 1000,70,34,33,472,716,987
00134 340 DATA 1000,70,34,33,472,716,987
00135 350 DATA 1000,70,34,33,472,716,987
00136 360 DATA 1000,70,34,33,472,716,987
00137 370 DATA 1000,70,34,33,472,716,987
00138 380 DATA 1000,70,34,33,472,716,987
00139 390 DATA 1000,70,34,33,472,716,987
00140 400 DATA 1000,70,34,33,472,716,987
00141 410 DATA 1000,70,34,33,472,716,987
00142 420 DATA 1000,70,34,33,472,716,987
00143 430 DATA 1000,70,34,33,472,716,987
00144 440 DATA 1000,70,34,33,472,716,987
00145 450 DATA 1000,70,34,33,472,716,987
00146 460 DATA 1000,70,34,33,472,716,987
00147 470 DATA 1000,70,34,33,472,716,987
00148 480 DATA 1000,70,34,33,472,716,987
00149 490 DATA 1000,70,34,33,472,716,987
00150 500 DATA 1000,70,34,33,472,716,987
00151 510 DATA 1000,70,34,33,472,716,987
00152 520 DATA 1000,70,34,33,472,716,987
00153 530 DATA 1000,70,34,33,472,716,987
00154 540 DATA 1000,70,34,33,472,716,987
00155 550 DATA 1000,70,34,33,472,716,987
00156 560 DATA 1000,70,34,33,472,716,987
00157 570 DATA 1000,70,34,33,472,716,987
00158 580 DATA 1000,70,34,33,472,716,987
00159 590 DATA 1000,70,34,33,472,716,987
00160 600 DATA 1000,70,34,33,472,716,987
00161 610 DATA 1000,70,34,33,472,716,987
00162 620 DATA 1000,70,34,33,472,716,987
00163 630 DATA 1000,70,34,33,472,716,987
00164 640 DATA 1000,70,34,33,472,716,987
00165 650 DATA 1000,70,34,33,472,716,987
00166 660 DATA 1000,70,34,33,472,716,987
00167 670 DATA 1000,70,34,33,472,716,987
00168 680 DATA 1000,70,34,33,472,716,987
00169 690 DATA 1000,70,34,33,472,716,987
00170 700 DATA 1000,70,34,33,472,716,987
00171 710 DATA 1000,70,34,33,472,716,987
00172 720 DATA 1000,70,34,33,472,716,987
00173 730 DATA 1000,70,34,33,472,716,987
00174 740 DATA 1000,70,34,33,472,716,987
00175 750 DATA 1000,70,34,33,472,716,987
00176 760 DATA 1000,70,34,33,472,716,987
00177 770 DATA 1000,70,34,33,472,716,987
00178 780 DATA 1000,70,34,33,472,716,987
00179 790 DATA 1000,70,34,33,472,716,987
00180 800 DATA 1000,70,34,33,472,716,987
00181 810 DATA 1000,70,34,33,472,716,987
00182 820 DATA 1000,70,34,33,472,716,987
00183 830 DATA 1000,70,34,33,472,716,987
00184 840 DATA 1000,70,34,33,472,716,987
00185 850 DATA 1000,70,34,33,472,716,987
00186 860 DATA 1000,70,34,33,472,716,987
00187 870 DATA 1000,70,34,33,472,716,987
00188 880 DATA 1000,70,34,33,472,716,987
00189 890 DATA 1000,70,34,33,472,716,987
00190 900 DATA 1000,70,34,33,472,716,987
00191 910 DATA 1000,70,34,33,472,716,987
00192 920 DATA 1000,70,34,33,472,716,987
00193 930 DATA 1000,70,34,33,472,716,987
00194 940 DATA 1000,70,34,33,472,716,987
00195 950 DATA 1000,70,34,33,472,716,987
00196 960 DATA 1000,70,34,33,472,716,987
00197 970 DATA 1000,70,34,33,472,716,987
00198 980 DATA 1000,70,34,33,472,716,987
00199 990 DATA 1000,70,34,33,472,716,987
00200 1000 DATA 1000,70,34,33,472,716,987

```

NO DIAGNOSTICS.

END OF COMPILATION  
 PLT3 SYMBOLIC  
 PLT3 CODE RELOCATABLE

15 AUG 73 15149146 0 01441882 14 24 (DELETED)  
 16 AUG 73 18149143 0 01442272 24 1 (DELETED)  
 0 01442322 14 17

29 JUN 74 8138138-394

FOR TRANS, TRANS  
UNLAC JLR CARTAN Y EXEC 11 LEVEL 28A - EXECUT LEVEL F12010010A1  
THIS COMPILE WAS DONE ON 29 JUN 74 AT 08138138

SUBROUTINE TRANS ENTRY POINT 000122

STORAGE USED: CODE(1) 000441 DATA(1) 000001 BLANK COMMON(2) 000000

COMMON BLOCKS:

0003 ACVA 000044  
0004 TRANS 000004

EXTERNAL REFERENCES (BLOCK, NAME)

0005 AMATX  
0006 SRT  
0007 NEN38

STORAGE ASSIGNMENT BLOCK TYPE RELATIVE LOCATIONS NAME

0001 000010 1100 0001 000015 1310 0001 000017 1340 0001 000018 1400 0000 R 000011 A  
0003 R 000000 AL 0000 R 000027 CB 0000 R 000028 CT 0000 000008 FILL 0000 000030 I  
0000 000024 1400 0000 000031 J 0000 J 000032 K 0000 000032 M 0000 R 000032 M  
0000 R 000025 M38 0000 R 000026 SB 0000 R 000024 ST 0000 R 000000 T

SUBROUTINE TRANS

00101 10 DIMENSION T(13,3),A(13,3)  
00102 20 COMMON /ACVA / A(13,3),FILL(13,3),RE(3,3)  
00103 30 COMMON / TRANS / T(13,3)  
00104 40 CALL AMATX(A)  
00105 50 DO 20 K=1,3  
00106 60 T(K,1) = 0  
00107 70 T(K,2) = 0  
00108 80 T(K,3) = 0  
00109 90 CT = RSQ(A)/K  
00110 100 SB = RSQ(A)/RSQ  
00111 110 CB = RS(2,3)/RSQ  
00112 120 T(1,1) = ST  
00113 130 T(1,2) = 0  
00114 140 T(1,3) = CT  
00115 150 T(2,1) = CT\*SB  
00116 160 T(2,2) = CB  
00117 170 T(2,3) = -ST\*SB  
00118 180 T(3,1) = CB\*CT  
00119 190 T(3,2) = -SB  
00120 200 T(3,3) = -CB\*ST  
00121 210 DO 10 I=1,3  
00122 220 DO 10 J=1,3  
00123 230 T(K,I) = 0  
00124 240 DO 10 L=1,3  
00125 250 T(K,L) = T(K,L)+T(L,I)\*A(I,J)  
00126 260

00196 260 20 CONTINUE  
00190 270 RETURN  
00191 280 END

END OF COMPILATION: NO DIAGNOSTICS.

TYRANS SYMBOLIC  
TYRANS CODE RELOCATABLE

15 AUG 73 18149128 0 01440400 14 24 DELETED  
15 AUG 73 18149128 1 01441280 24 14 DELETED  
0 01441300 14 14

8758139.025

29 JUN 74

GA XGT CONADS

STARTING ADDRESS 014000

CORE LIMITS 014000 041377 062442 163771 163772 163777

CONADS/CASE

0 062312-062442

1 014000-014066

NSTOPS/RLECS

1 014067-014100

NLECS/RLECS

0 062470-062470

1 014101-014104

2 062471-062565

NFTS/RLECS

1 014105-014134

2 062566-062602

NFTS/RLECS

1 014135-014167

2 062603-062671

NFTS/RLECS

1 014168-014194

2 062672-062735

NFTS/RLECS

1 014195-014224

2 062736-062735

PPA/MS/CODE

1 014225-014330

DEPTH /\*\*\*\*\*

0 062736-062743

NFTS/RLECS

0 062744-062733

1 014331-014373

NFTS/RLECS

1 014374-014394

2 062734-062734

ROUTE / RLECH  
 0 063165-063171  
 1 017046-020050  
 2 063172-063207

MTAB / CODE  
 0 063210-063356

NRDCV / RLECH  
 0 063357-063543

PLOT / CODE  
 0 063544-130461  
 1 020051-021143

NPIMP / RLECH  
 1 021144-021425  
 2 150662-150662

NRUPP / RLECH  
 1 021426-021450  
 2 150663-151673

NRWDE / RLECH  
 1 021451-021843

PRMT / CODE  
 0 151674-151730  
 1 021844-021712

NRXPI / RLECH  
 1 021713-021746  
 2 151731-151731

NRPLA / CODE  
 0 151732-151781  
 1 021747-022072

RTOP / CODE  
 1 022073-022127

JUNK / CODE  
 0 151782-151782

PNODE / CODE  
 1 022130-022235

SCCTA / CODE  
 0 151783-152054

PLT3 / CODE  
 0 152057-152135  
 1 022236-022432

PLOT1 / CODE  
 1 022433-022556  
 2 152136-152144

PLN2R /CODE  
1 022557-022763  
2 152145-152177

VEPR /CODE  
0 152200-152240  
1 022733-023333

PLXPLT /CODE  
0 152241-152251  
1 023334-023425

SCALEX /CODE  
0 152252-152264  
1 023426-023528

ALOG /RL24  
1 023529-023643  
2 152248-152326

CONSEL /CODE  
0 152326-152341  
1 023644-024007

GRIO /CODE  
0 152342-152400  
1 024008-025443

RVER /CODE  
0 152401-152414  
1 025444-025452

HEXPE8 /RL25  
1 025453-024735  
2 152415-152466

LABELY /CODE  
0 152467-152516  
1 024736-025146

CONV /CODE  
0 152517-152564  
1 025147-025443

BINGEC /CODE  
0 152565-152644  
1 025444-026033

VLAG /CODE  
0 152647-152674  
1 026034-026166

LABELX /CODE  
0 152677-152727  
1 026167-026413

FINDV /CODE



0 152730-152746  
1 026415-027016

NRPSR/RL24  
1 027017-027102  
2 152747-152776

LGRO /CODE  
0 152777-153044  
1 027103-027447

LABL /\*\*\*\*\*  
0 153045-153071

SC4020/\*\*\*\*\*  
0 153072-153214

NRKVS /CODE  
0 153215-155040  
1 027450-031112

RKINJT/CODE  
0 155041-155055  
1 031112-031152

NRKVS3/\*\*\*\*\*  
0 155056-155064

NRKVS2/\*\*\*\*\*  
0 155065-155350

INITL/CODE  
0 155351-155440  
1 031153-031301

PLQTD /\*\*\*\*\*  
0 155441-157431

DATAND/CODE  
0 157432-160411  
1 031302-032356

NINPTS/RLCS  
0 160412-160414  
1 032357-033474  
2 160415-160452

NININS/RLCS  
1 033475-033432  
2 160453-160502

ELEC /\*\*\*\*\*  
0 160503-160550

HYDR /\*\*\*\*\*  
0 160551-160601

INCE00/\*\*\*\*\*

0	160602-16061
FCM /CODE	
0	160642-160742
1	033633-034117
SINCS/RL24	
1	033120-033231
2	160763-161004
OUTPUT/CODE	
0	161005-161247
1	034252-035120
NFOUITS/RLCS	
1	035121-035352
2	161250-161251
MYSEL/CODE	
0	161252-161311
1	035353-035670
AMATRX/CODE	
0	161312-161332
1	035671-036004
COLUM /CODE	
0	161333-161401
1	036005-036165
CROSS /CODE	
0	161402-161511
1	036166-036230
CFM /CODE	
0	161412-161444
1	036231-036424
FORCES/*****	
0	161447-161462
GJR /CODE	
0	161463-161550
1	036425-037304
OVERFL/RL22	
1	037305-037313
MNATRX/CODE	
0	161551-161723
1	037314-037774
M3X3 /CODE	
0	161724-161747
1	037775-040062
TTRANS/CODE	
0	161750-162025

1 040063-040226

SGRT /RL24

0 162026-162031

1 040227-040244

2 162032-162037

ACIRD /CODE

0 162040-162075

1 040267-040314

ACIAND/000000

0 162076-162117

ACAVAP/CODE

0 162320-162376

1 040415-040647

TRANS /000000

0 162177-162264

ACDVC /CODE

0 162265-162371

1 040650-041277

ACDVAC/000000

0 162372-162440

ACLVA /000000

0 162441-162504

ACSTRD/000000

0 162505-162514

MASS /000000

0 162515-163220

EGMC /000000

0 163221-163242

MTGRD/000000

0 163243-163250

MRKVS1/000000

0 163251-163337

PRCPND/000000

0 163340-163431

MTGRIC/000000

0 163432-163537

MTTLC/000000

0 163440-163771

D2-118544-2

END OF ALLOCATION 1103 0039A 09099

### 5.5 SAMPLE PROBLEM

The input data and output, both printout and plots, for a sample case are presented on the following pages. In the example, the table is commanded to move sinusoidally in the y direction with an amplitude of 0.1 inch. Although 18 frequency cases are specified, output from the first frequency case only is presented. In this example the valve dynamics, forward loop compensation filter, and position and rate feedback second-order filter are ignored. Rate command and rate feedback gains are set to zero.

FORESTA AND GEOMETRY DATA

	2.9000	1496.0	1496.0	.00000	.00000	.00000
TABLE MASS	2915.0					
MOMENTS AND PRODUCTS OF INERTIA						
FOR ACTIVE TABLE SYSTEM						
X TABLE STATION OF ACTUATOR SWIVEL JOINTS	30.0000			3.0000	-55.419	-3.0000
E.R.Y. TABLE C.G.	25.102	49.500	-55.419	-46.500	30.298	46.500
Y AND Z TABLE COORDINATES OF SWIVEL JOINTS	25.102	-49.500	30.298			
				114.12	-74.573	-116.82
Y AND Z INERTIAL COORDINATES	-64.311	123.18	-76.380	-5.4750	138.39	-98.0050
OF FLOOR SWIVEL JOINTS	-62.472	-122.68	138.46			

# ESTIMATING STRUCTURAL DATA

ACTUATOR BENDING DAMPING CONSTANT	20000-01
MASS OF ROD AND PISTON	47900
MOMENT OF INERTIA OF CYLINDER	4290.0
ABOUT FLOOR SWIVEL JOINT	
DISTANCE FROM FLOOR SWIVEL TO C.L.	112.00
OF PISTON ROD SEAL AT END OF CYLINDER	112.00
LENGTH OF PISTON ROD	124.00
RETRACTED LENGTH OF ACTUATOR	21000-09
BENDING MODULUS OF PISTON ROD	24.000
MAXIMUM STROKE OF ACTUATOR	

### PROCESSING FUNCTION DATA

	-125.30	.00000	.00000
INITIAL INERTIAL COORDINATES OF TABLE CG			
INITIAL Euler ANGLES OF TABLE COORDINATE	.00000	.00000	.00000
INITIAL SYSTEM			
SYSTEM W.R.T. INERTIAL SYSTEM			
MASS MATRIX AND GEOMETRY UPDATE OPTION	18		
NUMBER OF FREQUENCY CASES	0		
EXTERNAL FORCE AND MOMENT OPTION	0		
NUMBER OF EXTERNAL FORCE FREQUENCIES	37.699	50.265	87.964
NUMBER OF SIGNAL FREQUENCIES	125.66	157.08	201.06
CORRECTION SIGNAL FREQUENCIES	81.661	94.248	188.50
			150.80
			138.23
			113.10
			100.53
			.00000

SINUSOIDAL AMPLITUDES OF TRANSLATIONAL COMMANDS  
FOR TABLE CG AND OF TABLE EULER COMMANDS

HYDRAULICS DATA

	300.0	.10000-06	.12500-01	.12500-01	.12500-01
SUPPLY PRESSURE	.00000				40.000
EQUIVALENT SYSTEM BULK MODULUS	.12500-01				40.000
VALVE PRESSURE FLOW COEFFICIENT	40.000				
LEAKAGE COEFFICIENT ACROSS PISTON SEALS	40.000				
LEAKAGE COEFFICIENT DAMPING COEFFICIENT	7.0000				
ACTUATOR PUSH AND PULL STROKE WORKING AREAS	521.00				
ACTUATOR HYDRAULIC VOLUMES OF	.00000				
INITIAL RETRACTED ACTUATOR	.00000				
FULLY RETRACTED FORCE OF ACTUATORS					
COULOMB FRICTION FORCE OF ACTUATORS					

## ELECTRONICS DATA

## GAINS

ELECTRONICS AND VALVE FORWARD LOOP

DISPLACEMENT FEEDBACK AND COMMAND

VELOCITY FEEDBACK LOOP

PRESSURE FEEDBACK LOOP

VELOCITY COMMAND

BREAK FREQUENCIES OF FIRST ORDER FILTERS

DISPLACEMENT AND VELOCITY FEEDBACK

SECOND ORDER FILTER DAMPING CONSTANT

AND FREQUENCY

VALVE DYNAMICS DAMPING CONSTANT

AND FREQUENCY

## PROGRAM CONTROL DATA

START TIME

STOP TIME

OUTPUT FREQUENCIES

PRINT OPTION

PLOT OPTION

.....  
 • COMMAND SIGNAL FREQUENCY 1 37.3990 RAD/SEC •  
 • EXTERNAL FORCE FREQUENCY 1 .00000 RAD/SEC •  
 • START TIME 1 .00 STOP TIME 1 1.00 •  
 .....



TIME : 0.00000 SEC

INCREMENTAL INERTIAL MOTIONS OF TABLE C.B.

INCREMENTAL ANGULAR MOTIONS

INCREMENTAL VELOCITIES OF TABLE C.B.

EULER ANGLE RATES

TABLE POSITION ERROR (ACTUAL-COMMAND)

BENDING FREQUENCIES AT CYLINDER ROD SEAL

Y-LATERAL ELASTIC DISPLACEMENTS AT CYLINDER ROD SEALS

Z-LATERAL ELASTIC DISPLACEMENTS AT CYLINDER ROD SEALS

ACTUATOR STROKES

ACTUATOR VELOCITIES

ACTUATOR POSITION ERROR (ACTUAL-COMMAND)

NET FORCES ON ACTUATOR PISTONS

DERIVATIVE ARRAY

VARIABLE ARRAY

\* CHAR UN/FLOW AT 035745

\* CHAR UN/FLOW AT 035745

\* CHAR UN/FLOW AT 035745

\* CHAR UN/FLOW AT 035745





TIME : 6.210930-01 SEC

## INCREMENTAL INERTIAL MOTIONS OF TABLE C.G.

-362396-04 -647505-01 -754081-05

## INCREMENTAL ANGULAR MOTIONS

-165920-05 -490281-04 -747622-07

## INERTIAL VELOCITIES OF TABLE C.G.

-815374-03 -2774050 -191524-02

## FULLER ANGLE RATES

-132240-04 -183544-02 -878322-08

## TABLE POSITION ERROR (ACTUAL-COMMAND)

-362396-04 -341657-01 -754081-05 -6165920-05 -480284-04 -747622-07

## BENDING FREQUENCIES AT CYLINDER ROD SEAL

82.4040 82.4045 83.1524 83.1524 83.0479 83.5685

## Y LATERAL ELASTIC DISPLACEMENTS AT CYLINDER ROD SEALS

-893315-02 -137951-01 -138267-01 -911-81-02 -502154-02 -465442-02

## Z LATERAL ELASTIC DISPLACEMENTS AT CYLINDER ROD SEALS

-729549-02 -383360-02 -389504-02 -679479-02 -108751-01 -103505-01

## ACTUATOR STROKES

4214227 41.9037 42.1580 41.4527 42.2444 41.7394

## ACTUATOR VELOCITIES

-174873 -247248 -23267 -1.4689 1.2298 1.7284

## ACTUATOR POSITION ERROR (ACTUAL-COMMAND)

-172405-01 -824084-02 -585747-02 -168076-01 -227993-01 -229397-01

## NET FORCES ON ACTUATOR PISTONS

261.435 -16.4291 -20.9462 259.775 -241.559 -244.240

## DERIVATIVE ARRAY

-185237 97.2080 -431513-01 -724493-04 -525079-02 -108074

-215590 -38.2304 33.7306 23.0938 -125818 11.4889

-16.0781 -18.3236 -14.4371 -13.9842 30.6791 27.7193

-818374-03 -2174050 -191524-02 -143240-04 -183544-02 -878322-08

-409359 -867467 -655037 -443998 -230252 -235316

-377707 -405103-01 -350034-01 -409344 -425086 -4450616

603220 -3228730 -102264 615.327 -599.378 -807.355

-1114.98 587272 18.8543 -1082.26 105.34 1073.94

-000000 -000000 -000000 -000000 -000000 -000000

53.4854 7273127 6.4084 52.9325 -60.2539 -60.7798

-1.48975 -267246 -23267 -1.4689 1.7284 1.7284

-736137-02 -577003-03 -692372-03 -733392-02 -647620-02 -675655-02

-214643 -554745-02 -343167-02 -211677 -219775 -215405

-009000 -000000 -000000 -000000 -000000 -000000

-681015-03 -2774050 -191524-02 -143240-04 -183544-02 -878322-08

-409359 -867467 -655037 -443998 -230252 -235316

-377707 -405103-01 -350034-01 -409344 -425086 -4450616

-125.202 -647505-01 -754081-05 -6165920-05 -480284-04 -747622-07

-893315-02 -137951-01 -138267-01 -911281-02 -502154-02 -465442-02

-729549-02 -383360-02 -389504-02 -679479-02 -108751-01 -103505-01

1509.19 1508.75 1498.41 1509.44 1492.31 1492.02

1483.31 1502.23 1502.53 1483.66 1514.43 1514.27

-000000 -000000 -000000 -000000 -000000 -000000

-9.17239 -2113940 -1.93107 -8.99701 11.0982 11.1039

-1.4873 -237248 -23267 -1.4689 1.7284 1.7284

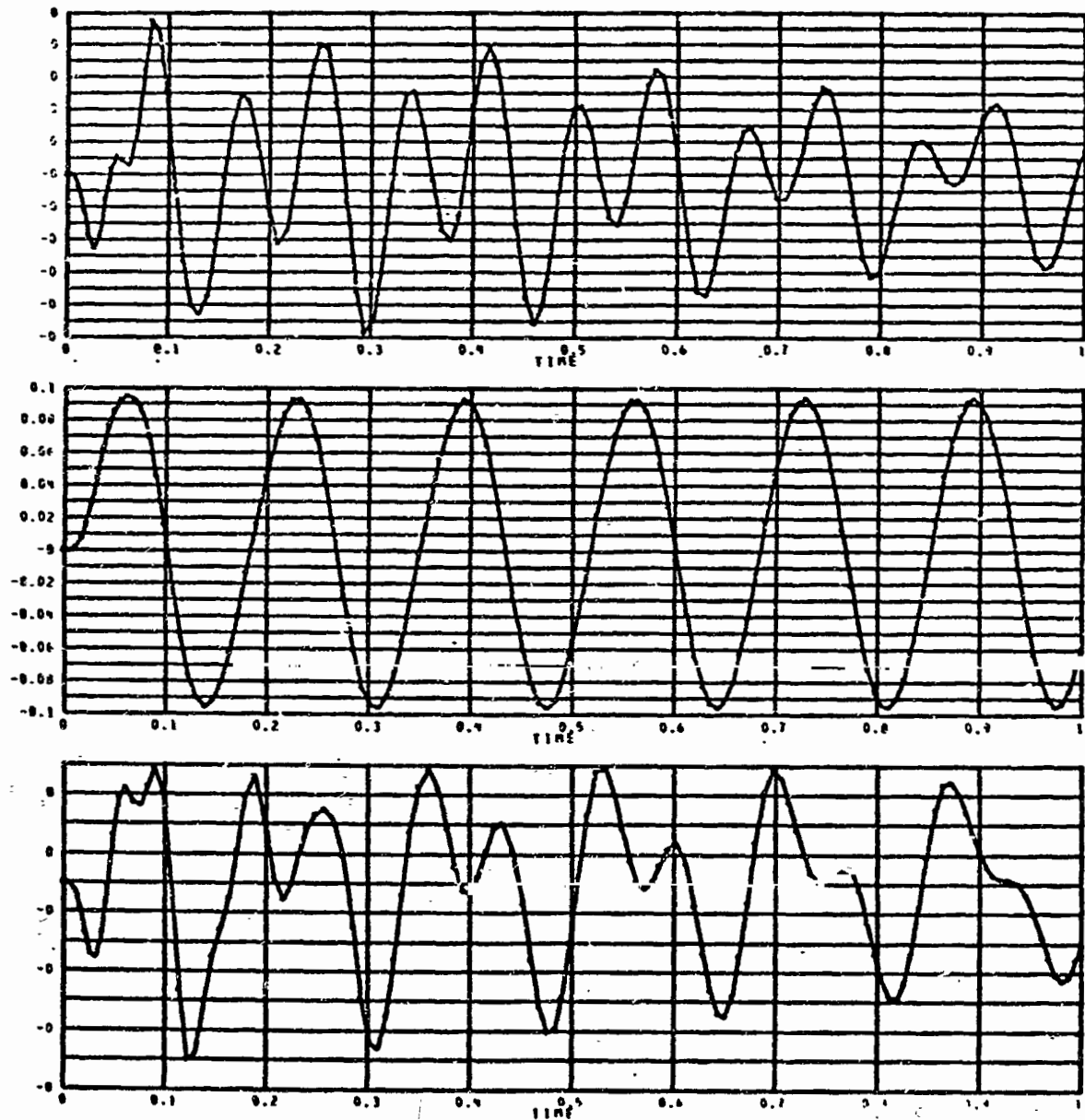
168.330 167.904 168.158 167.653 168.264 167.739

-122442-03 -184094-05 -364942-05 -120905-03 -120904-03 -125875-03

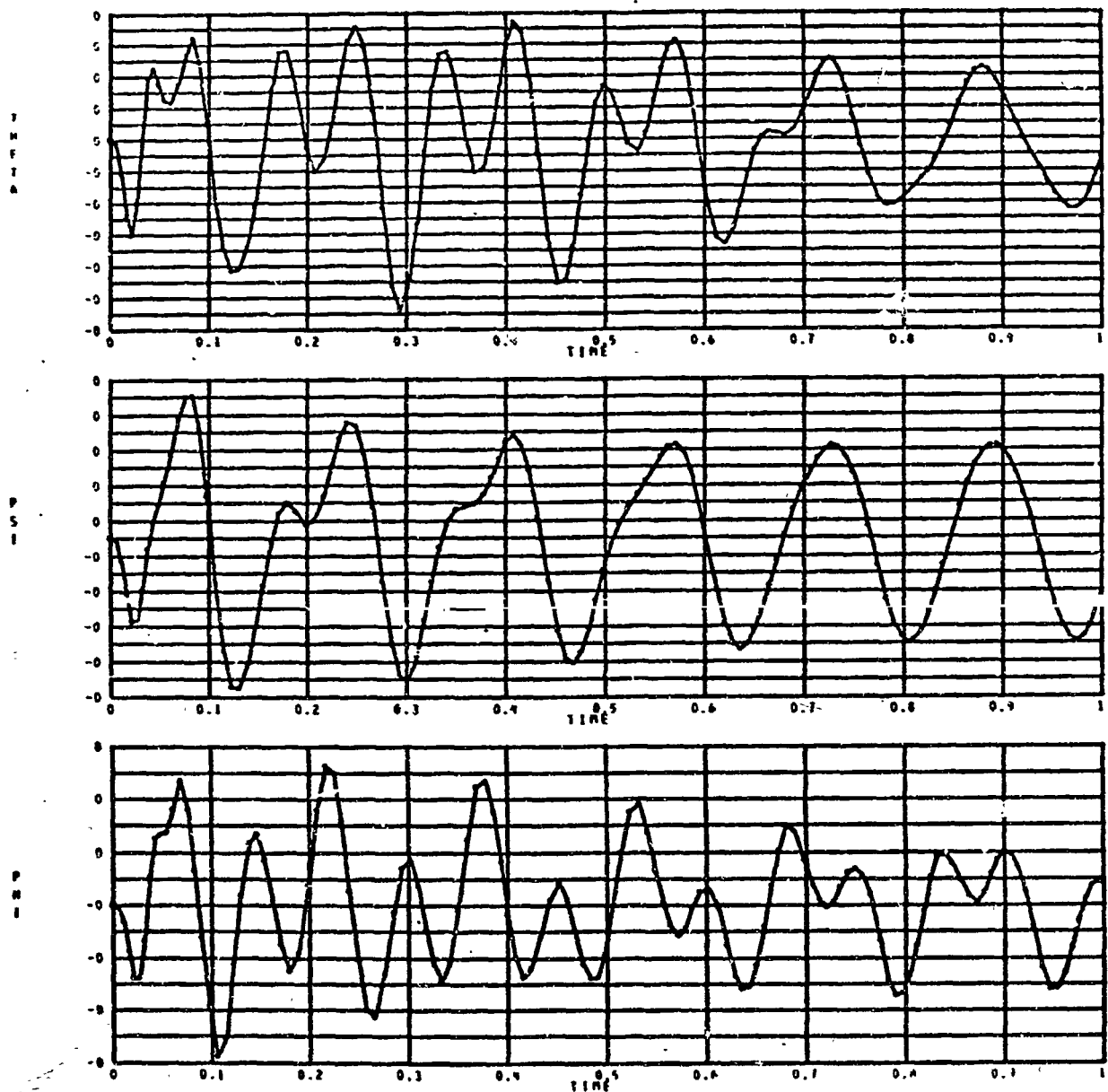
-701993-02 -585832-03 -700334-03 -197703-02 -634801-02 -641372-02

-242876-01 -585522-02 -515747-02 -237827-01 -293369-01 -293522-01

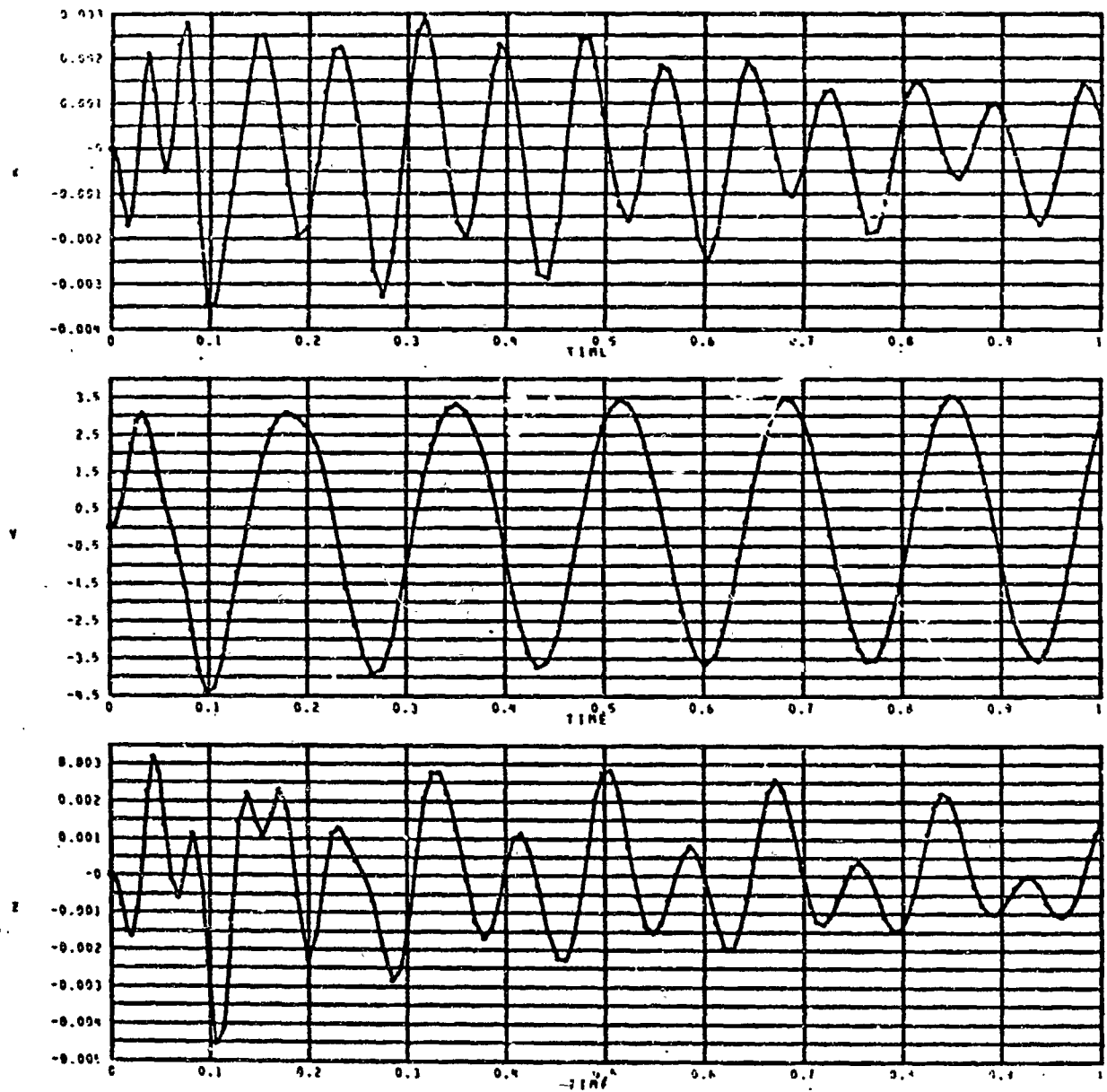
## INCREMENTAL INERTIAL MOTIONS OF TABLE C.G.



INCREMENTAL ANGULAR MOTIONS OF TABLE C.6.



INERTIAL VELOCITIES



EULER ANGLE VELOCITIES

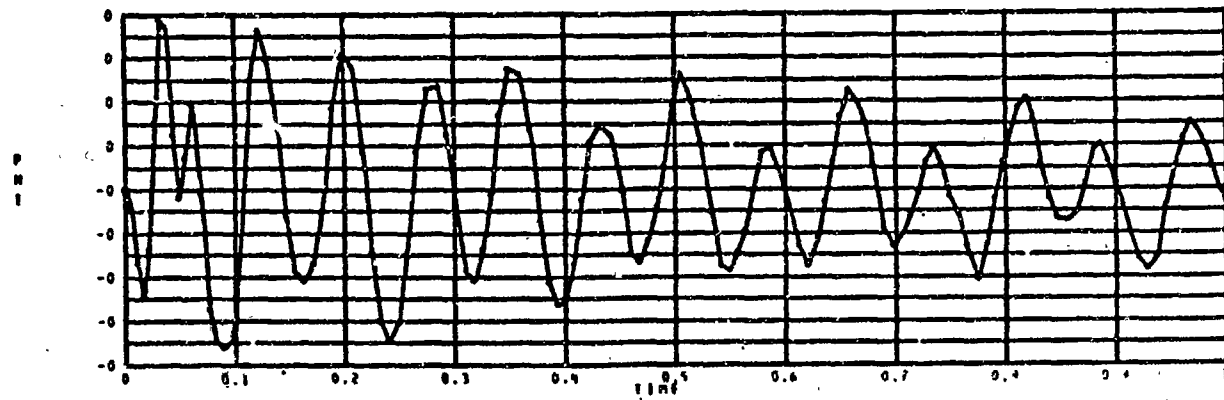
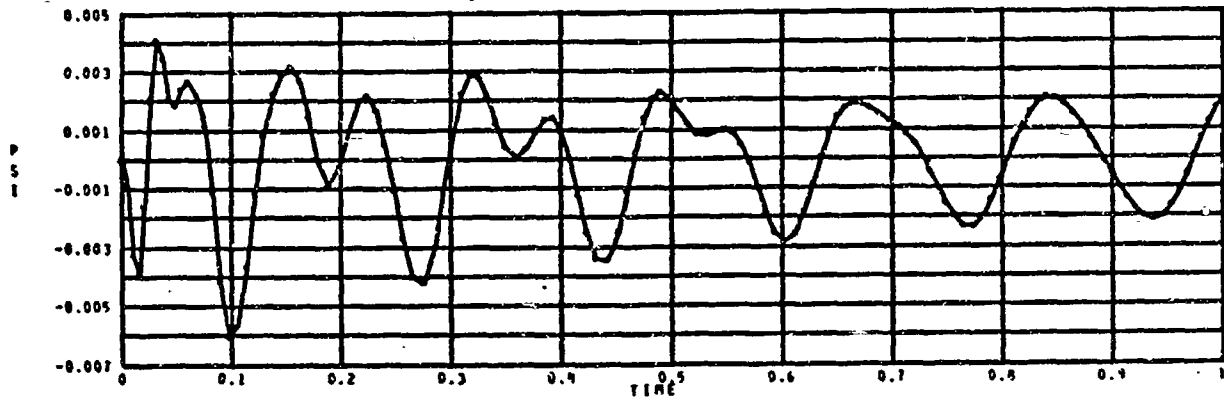
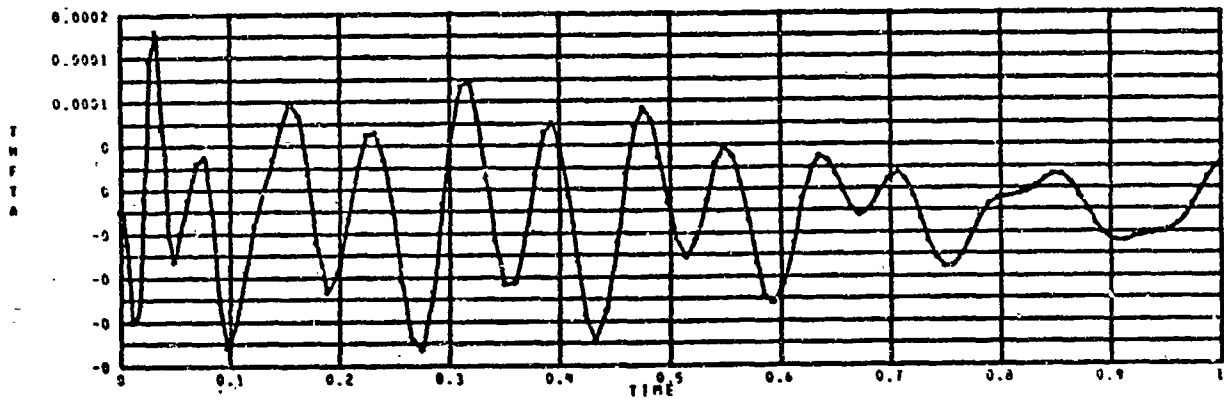




TABLE POSITION ERROR (ACTUAL-COMMANDED)

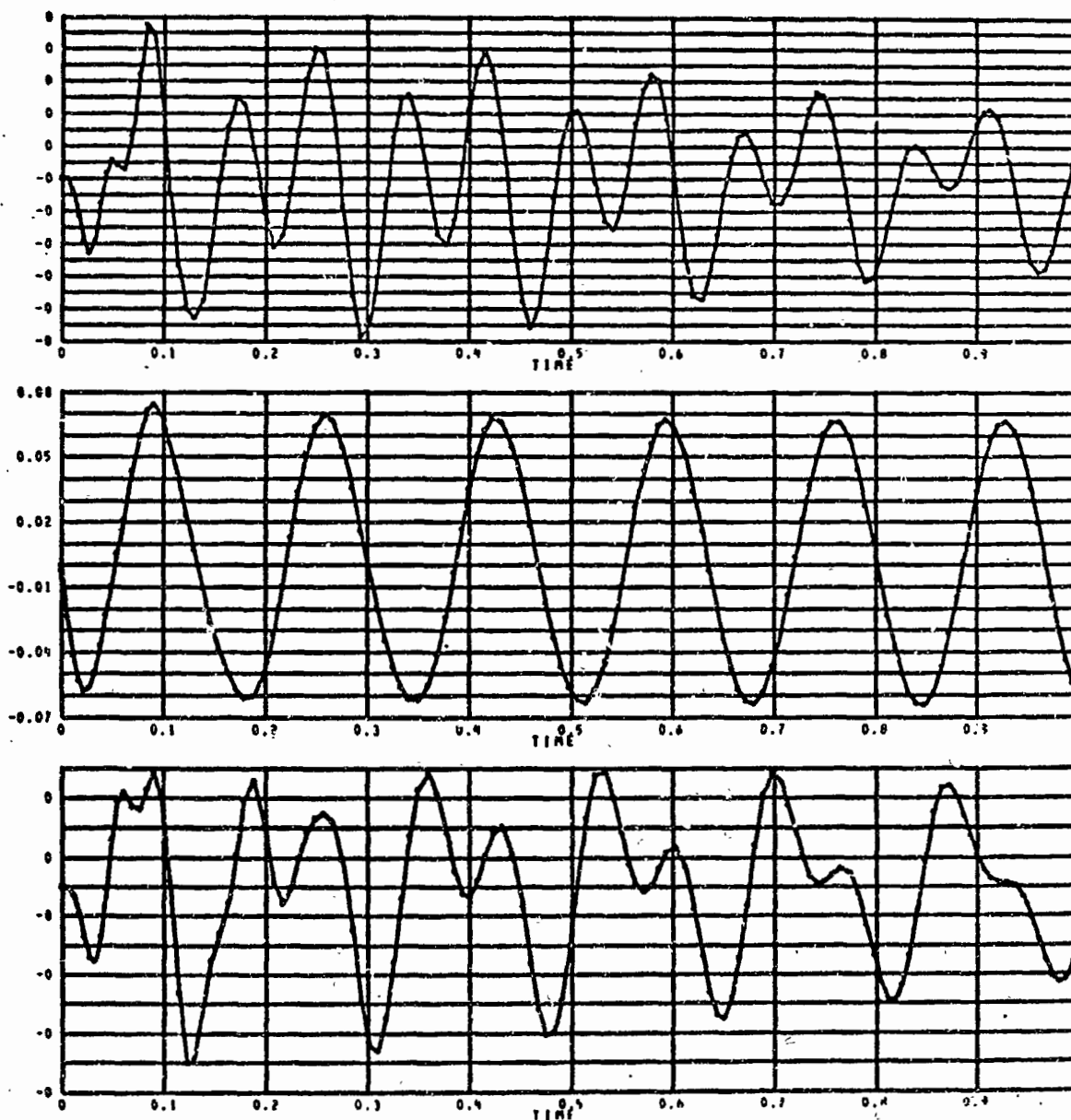
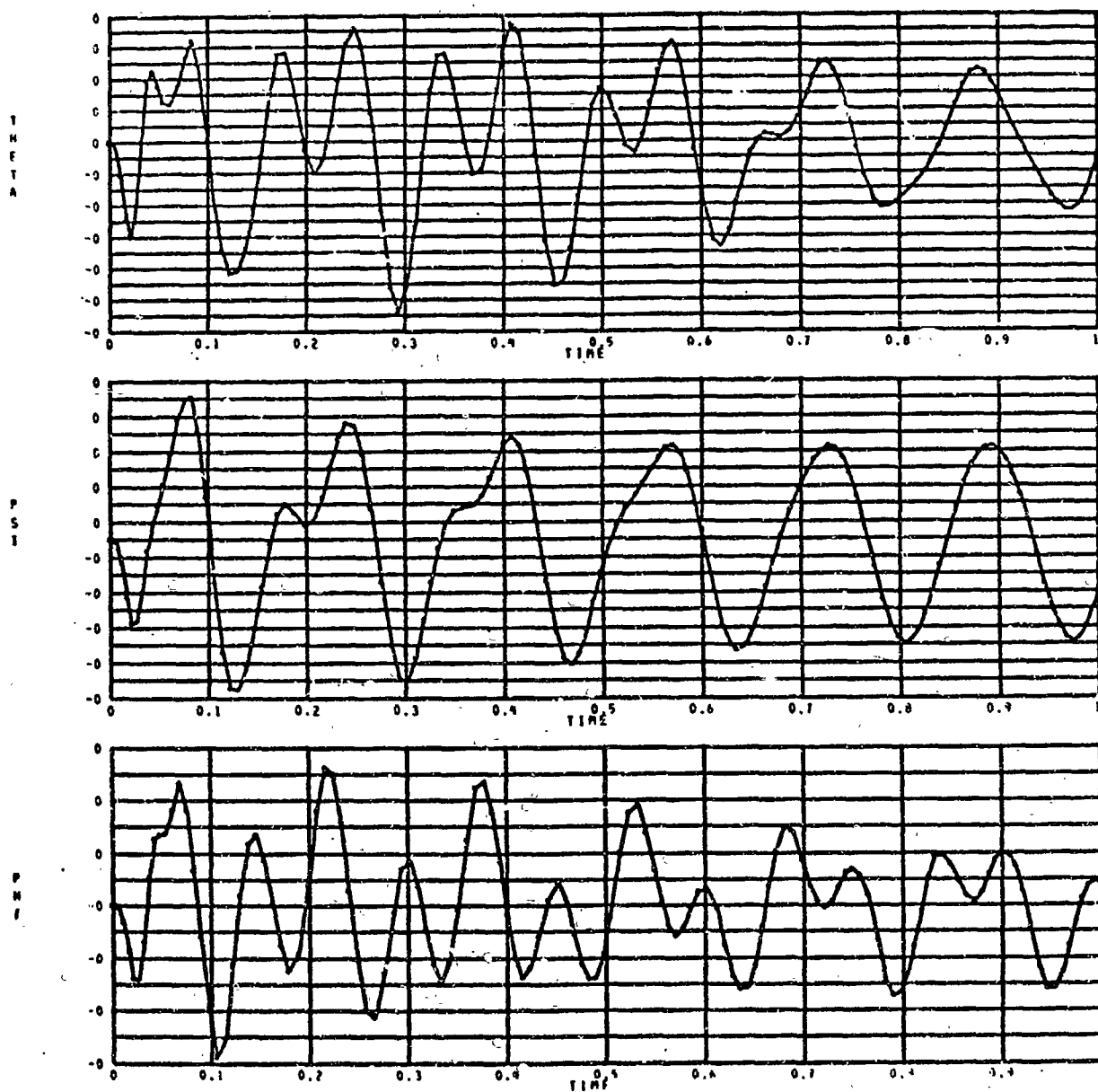
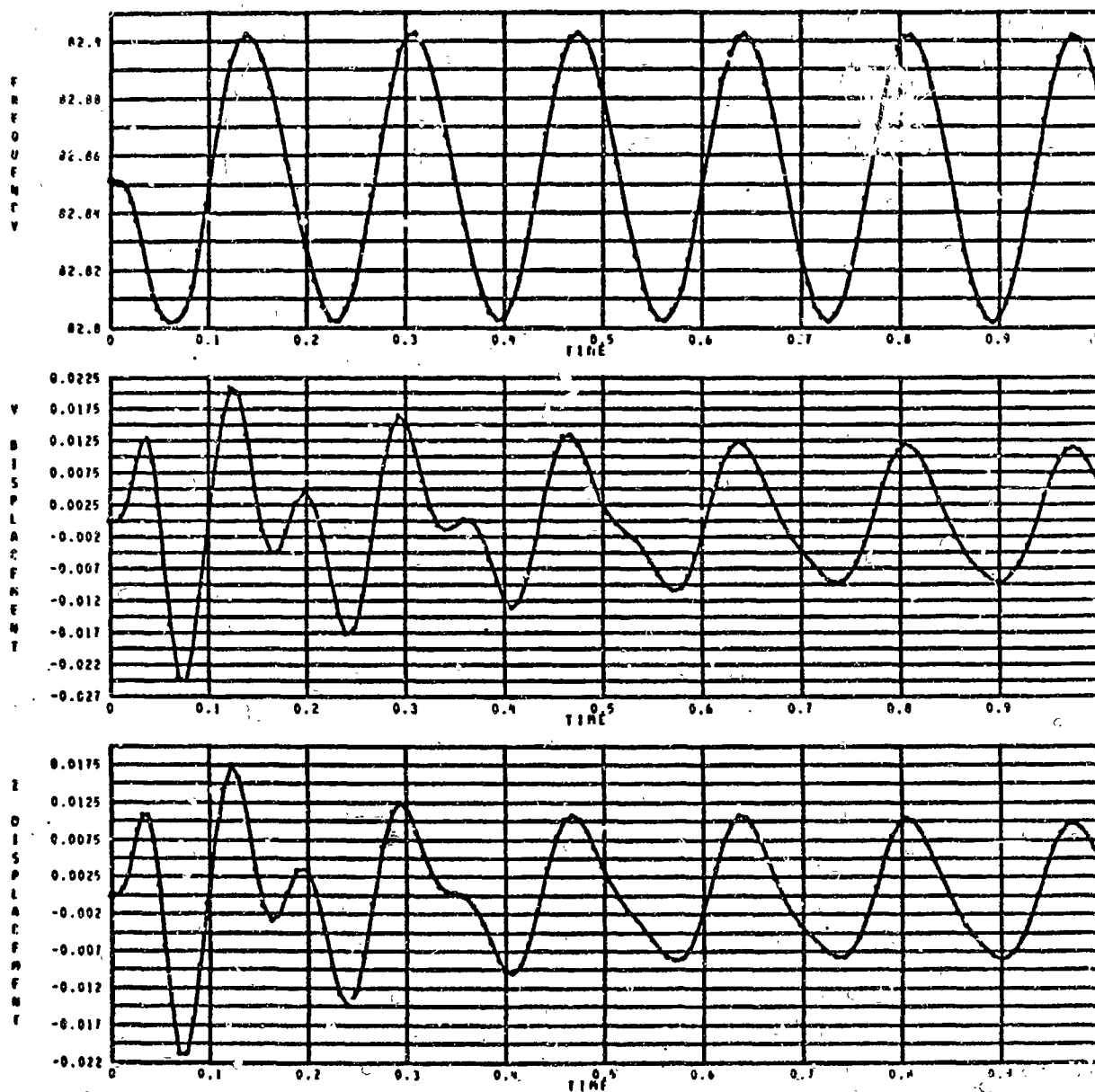


TABLE POSITION ERROR (ACTUAL-COMMANDED)

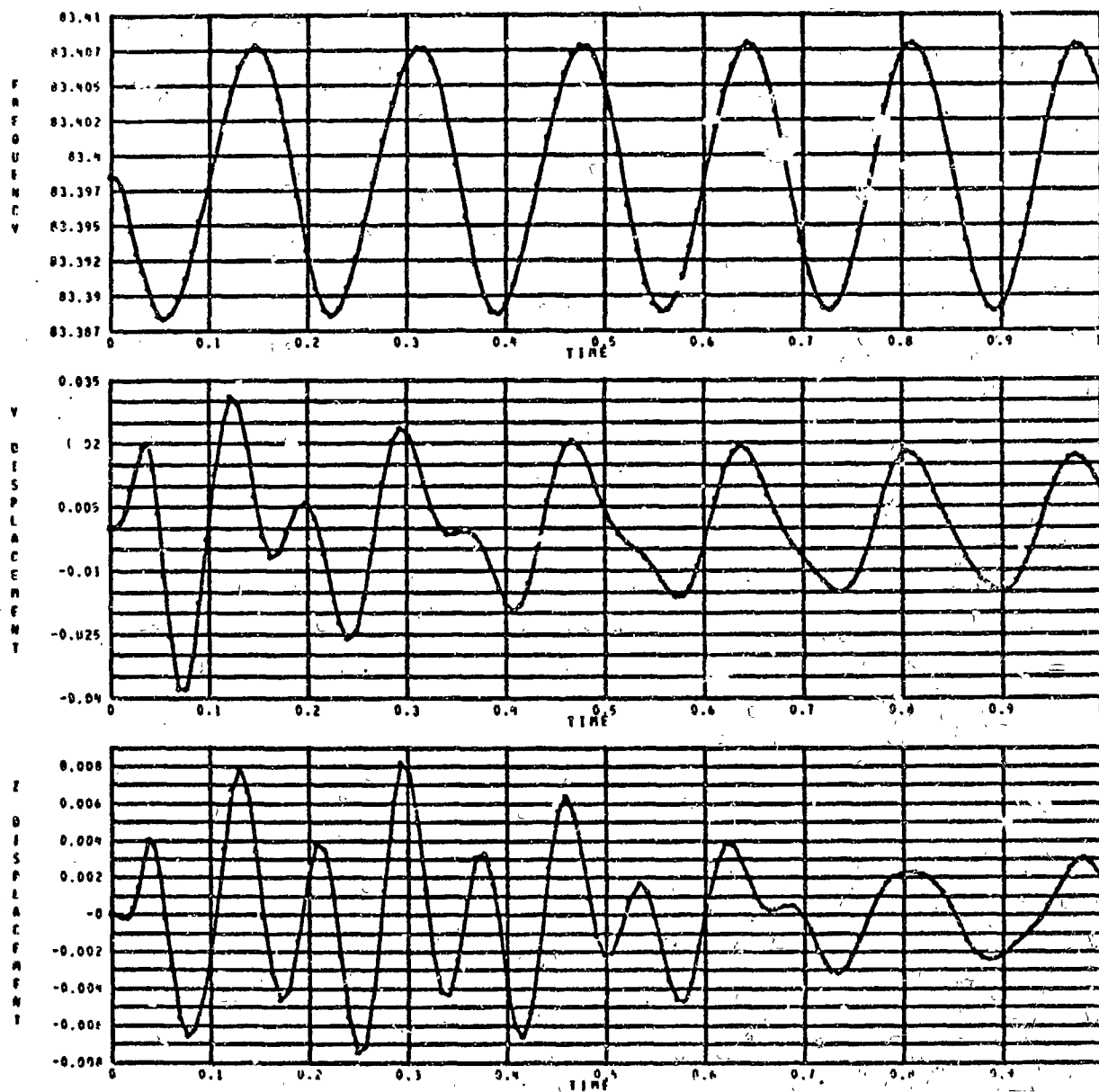


ACTUATOR SENDING DATA FOR ACTUATOR NO. 1

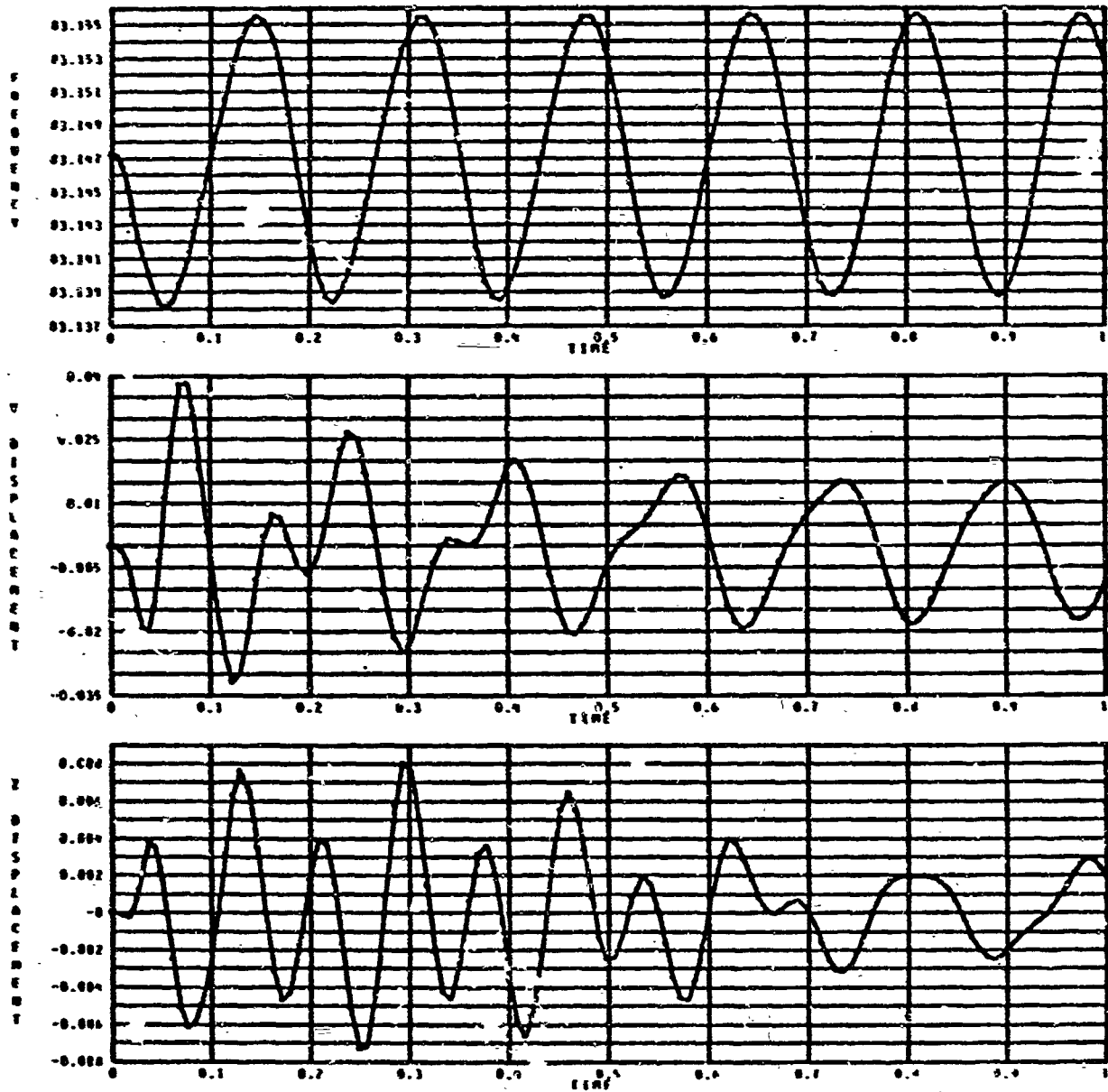


D2-118544-2

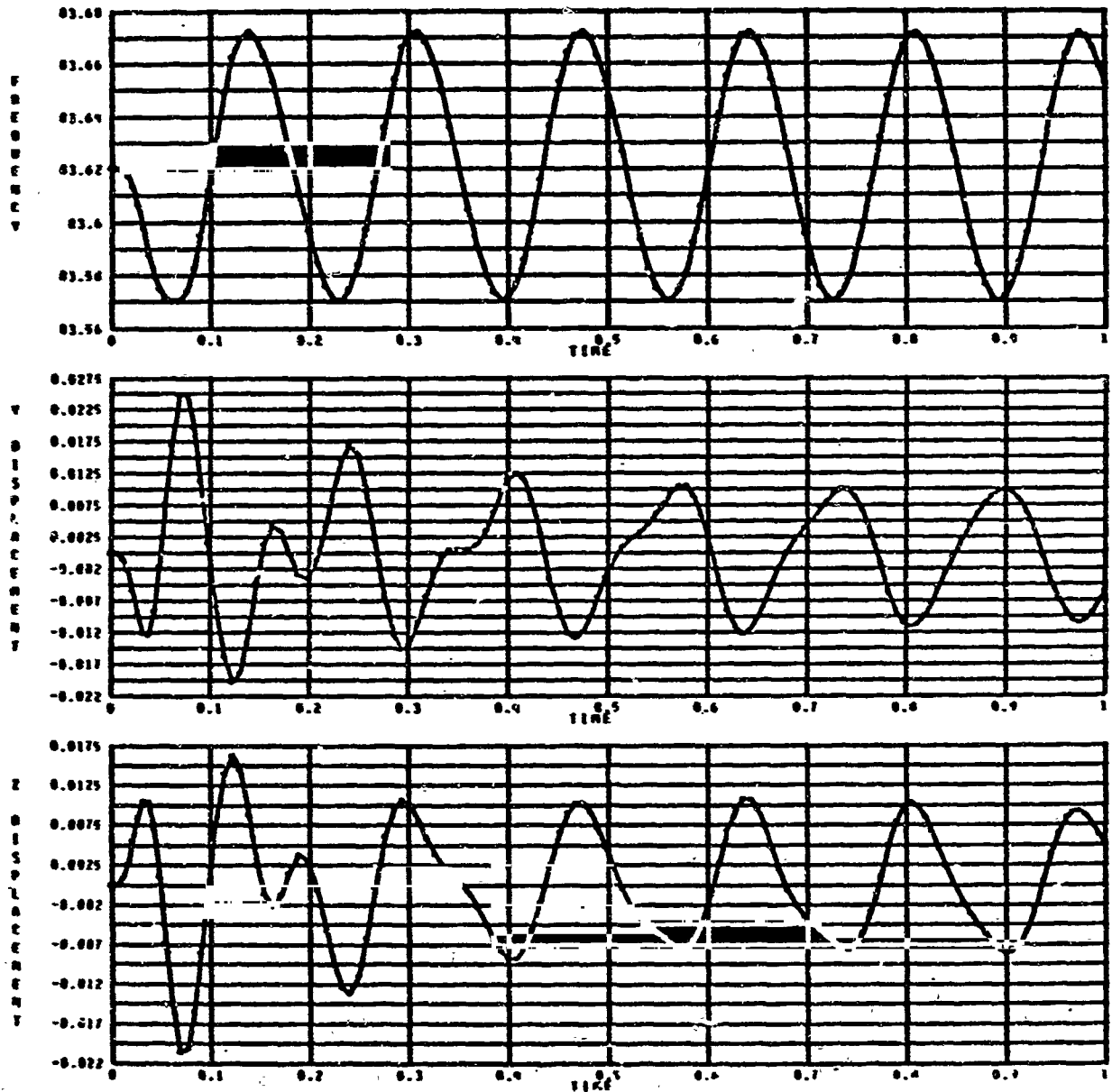
ACTUATOR BENDING DATA FOR ACTUATOR NO. 2



ACTUATOR BEARING DATA FOR ACTUATOR NO. 3

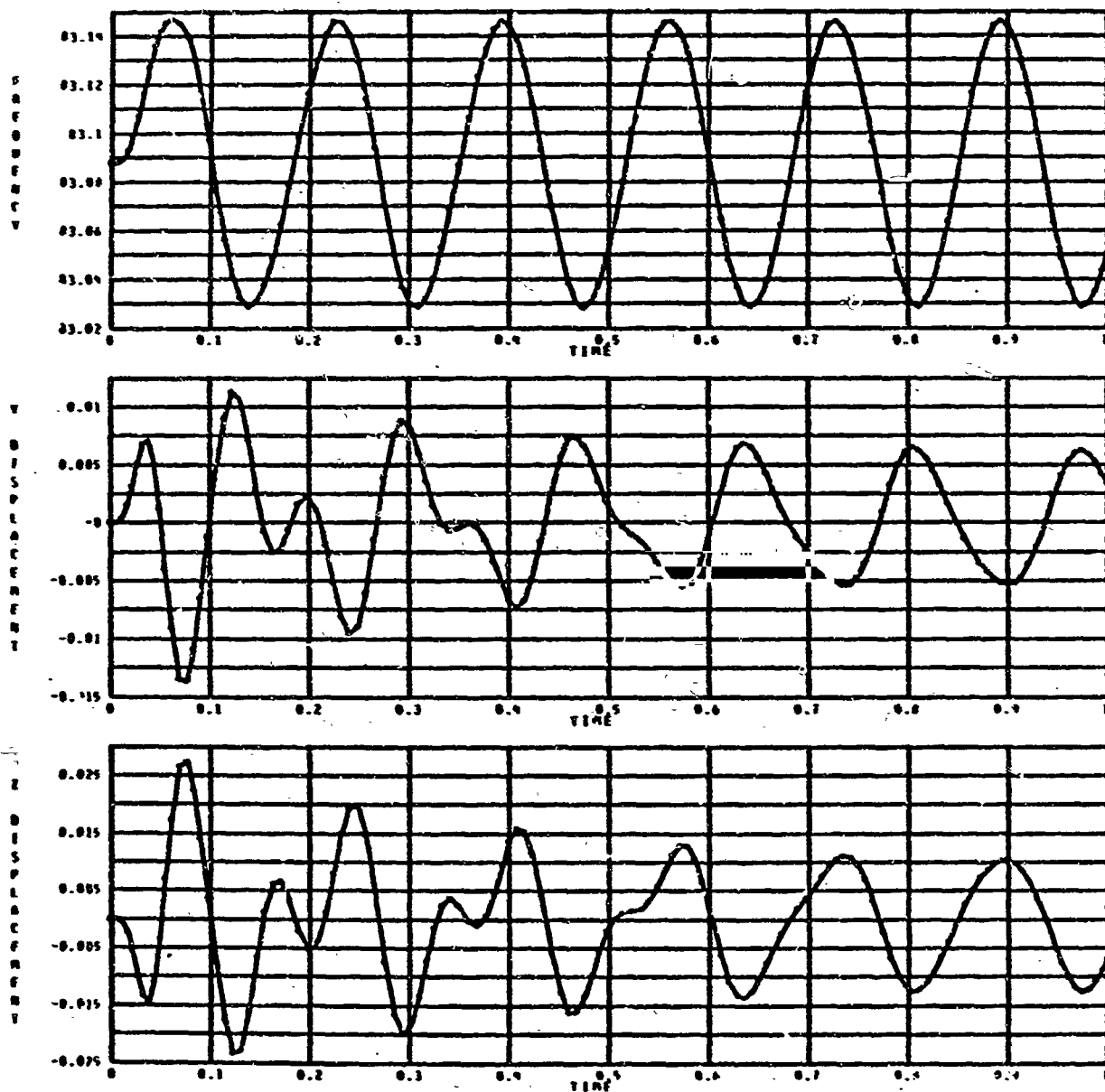


ACTUATOR SENSING DATA FOR ACTUATOR NO. 4



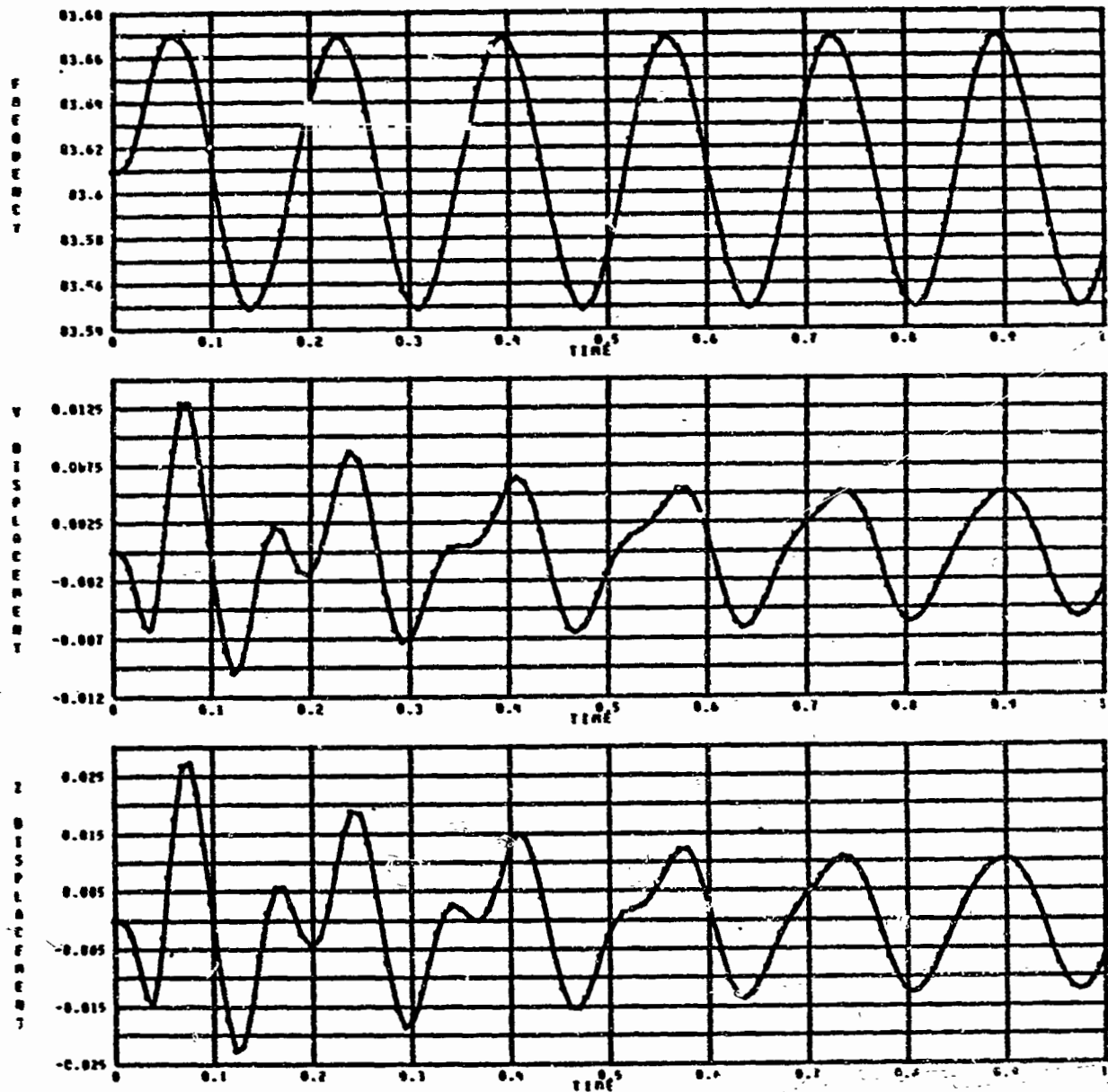
D2-118544-2

ACTUATOR SENSING DATA FOR ACTUATOR NO. 5



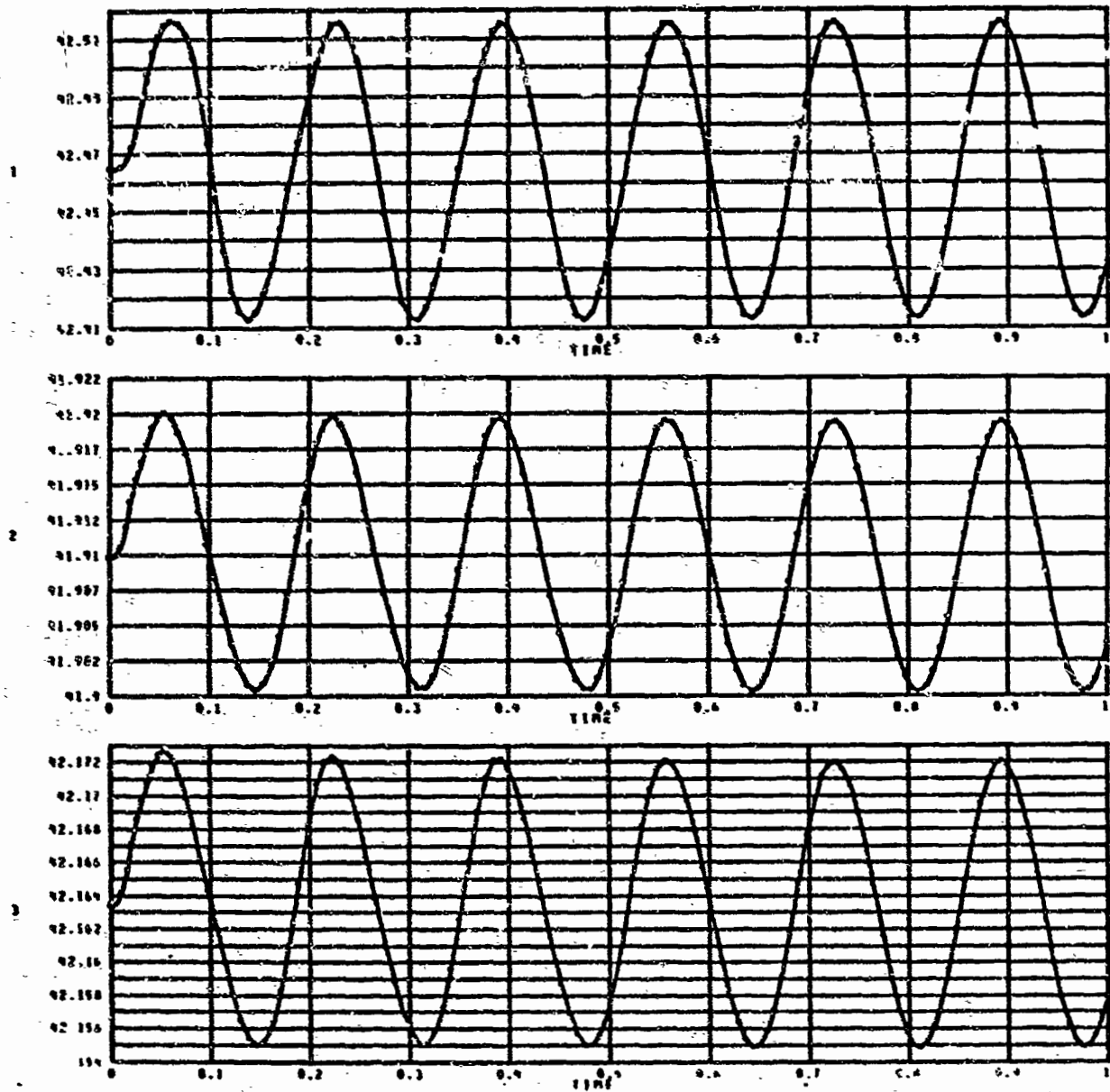
D2-118544-2

ACTUATOR BENDING DATA FOR ACTUATOR NO. 6

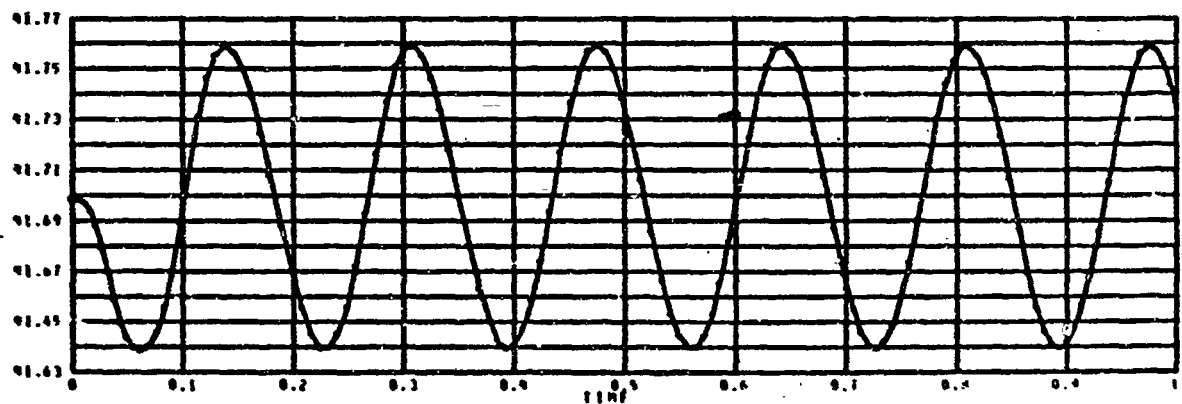
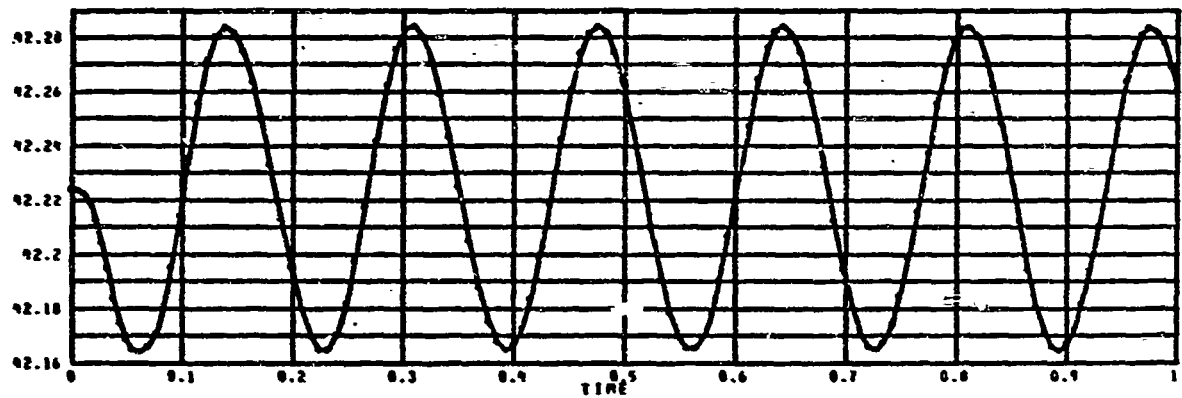
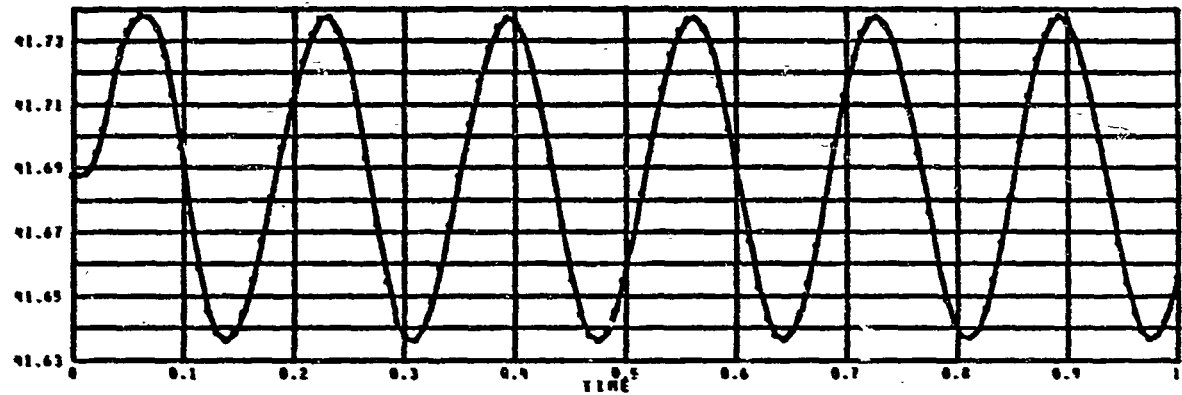




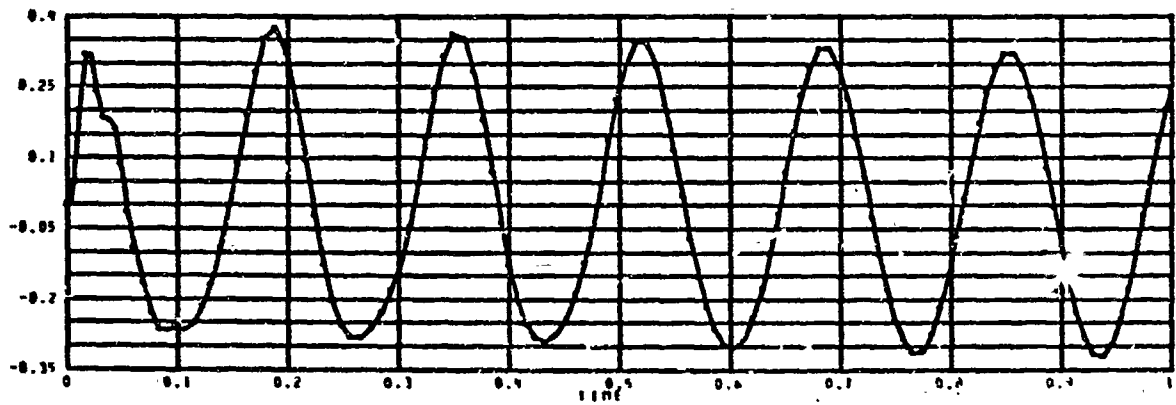
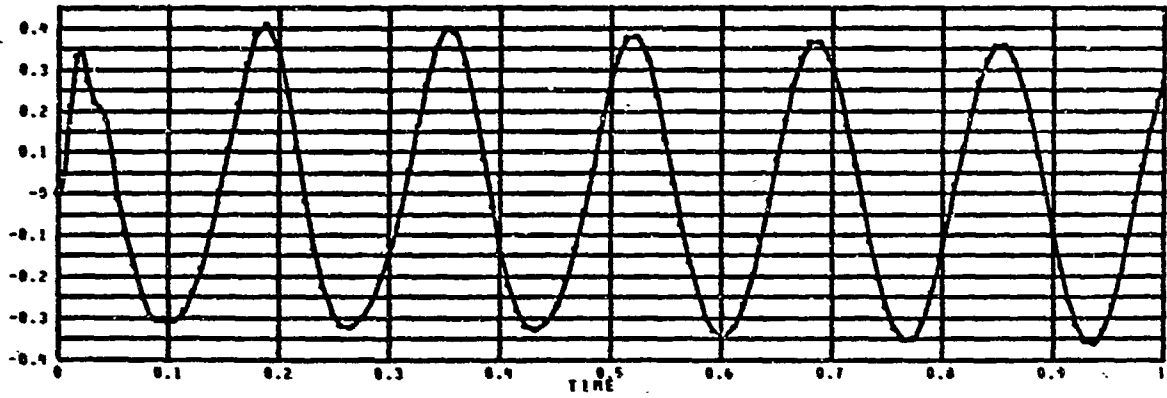
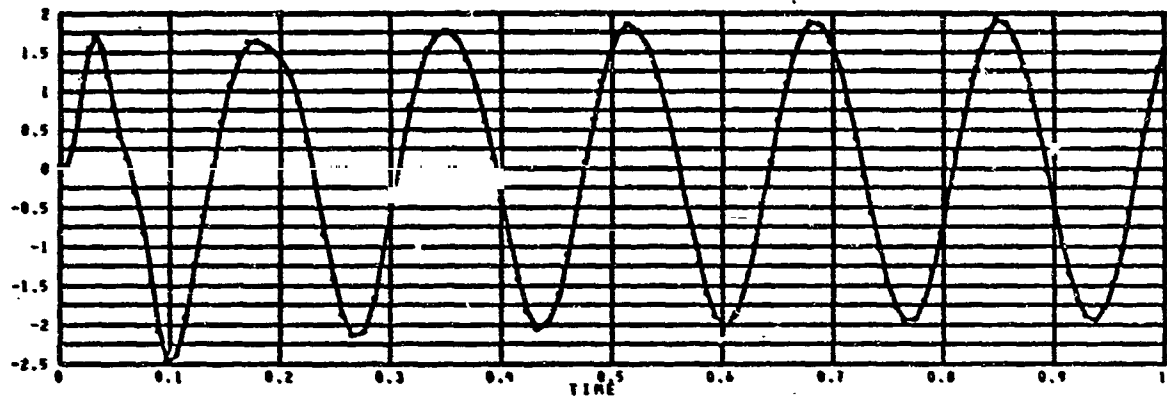
ACTUATOR STROKES



## ACTUATOR STROKES

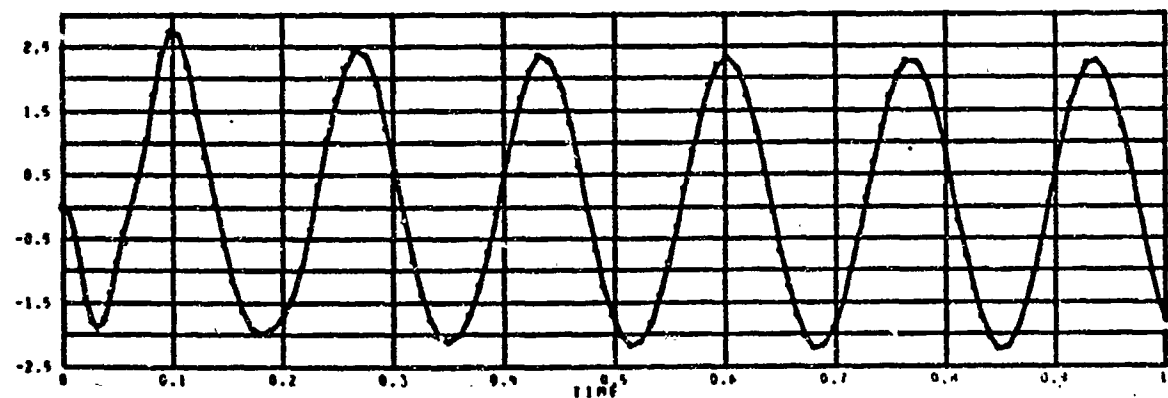
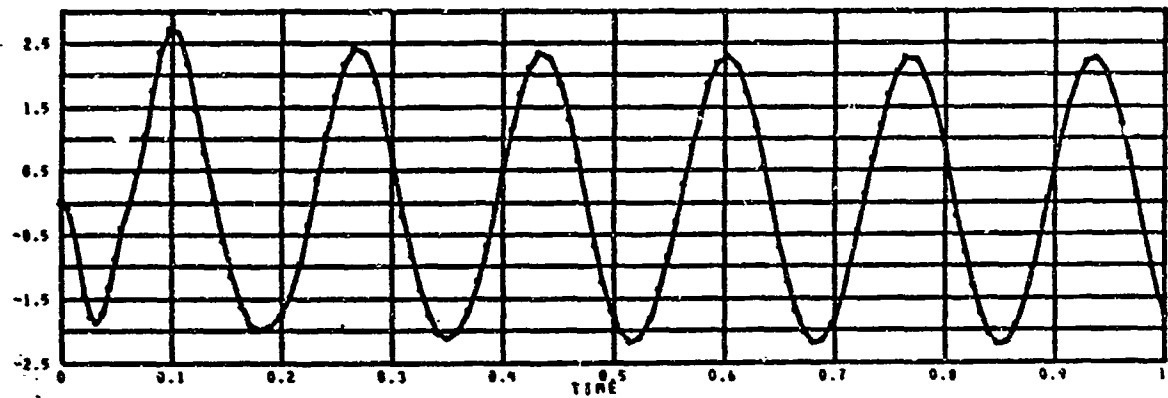
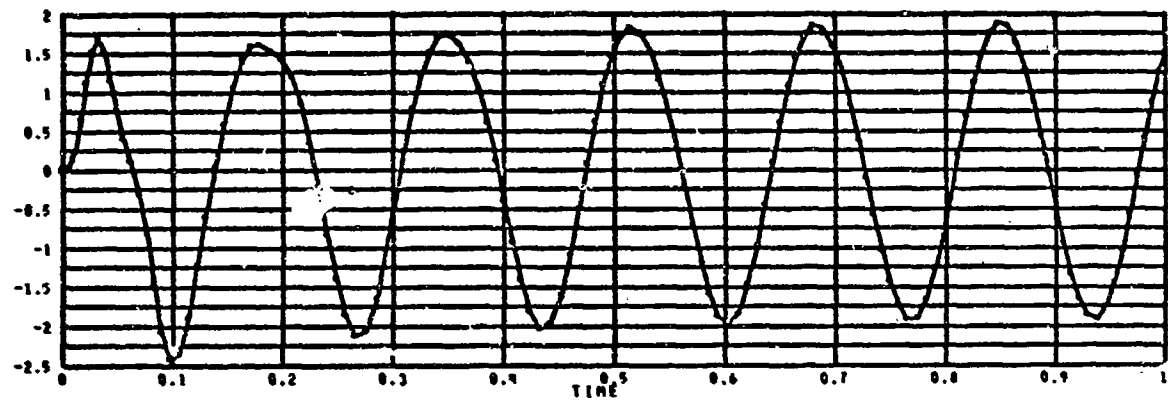


ACTUATOR VELOCITIES

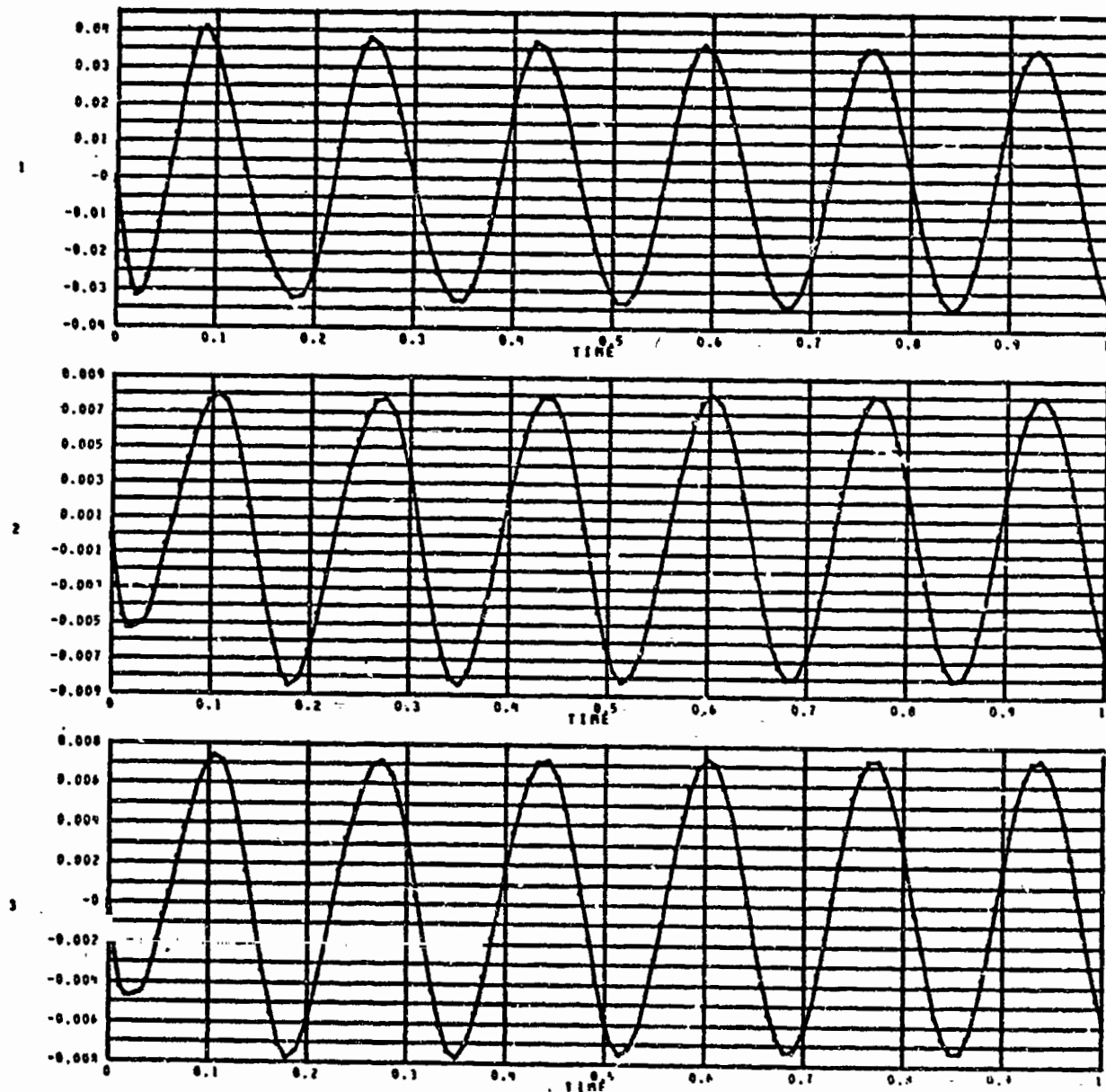


D2-118544-2

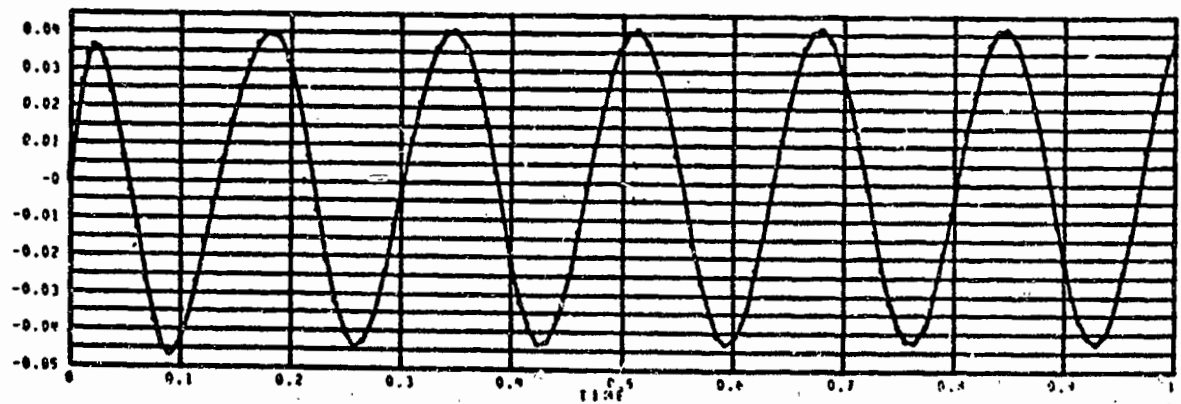
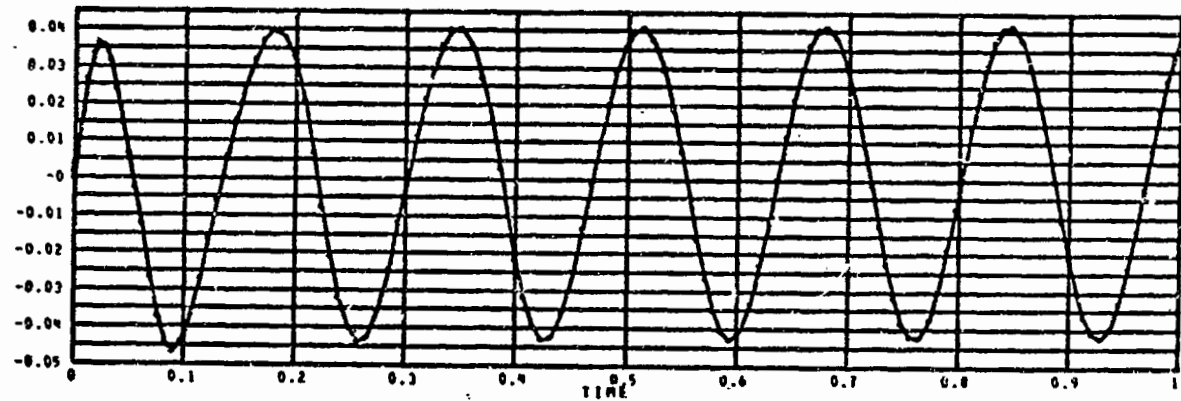
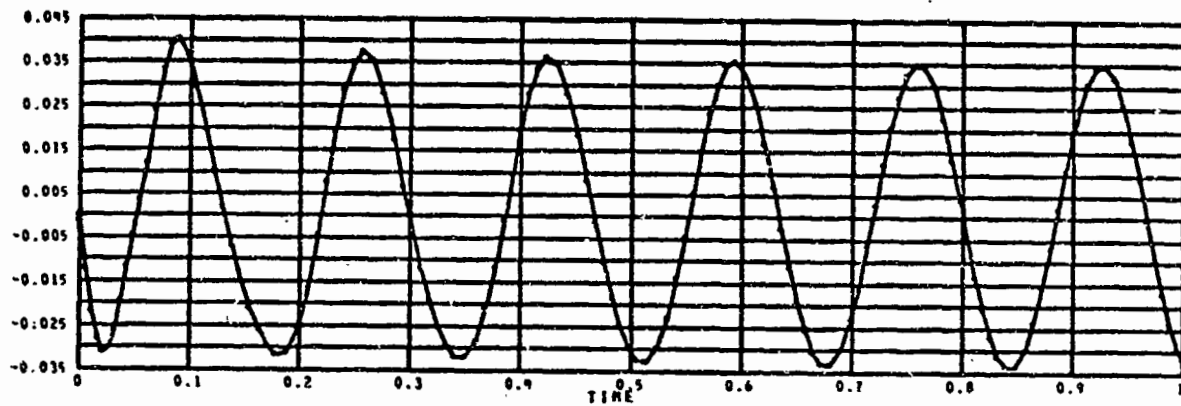
ACTUATOR VELOCITIES



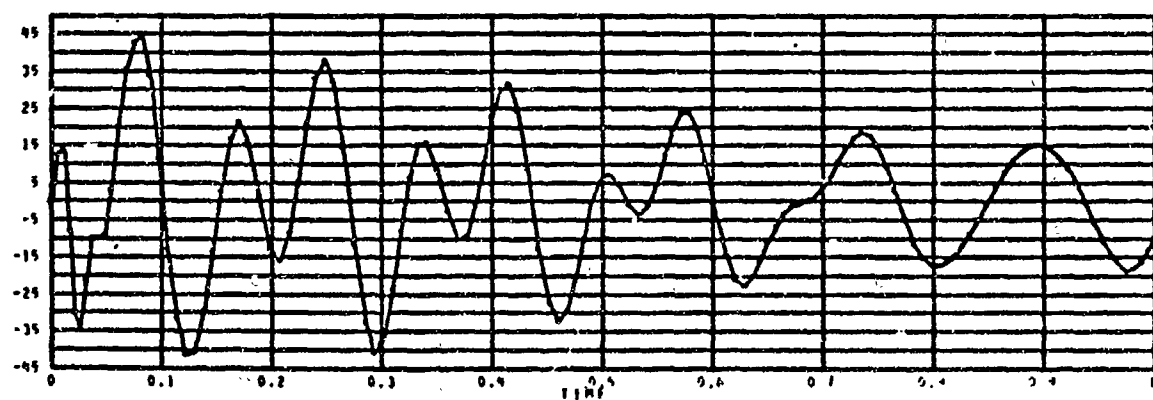
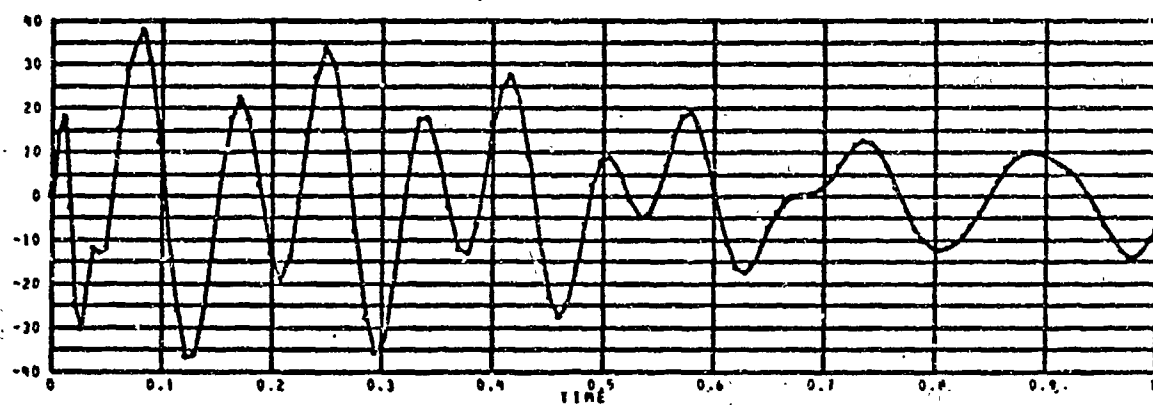
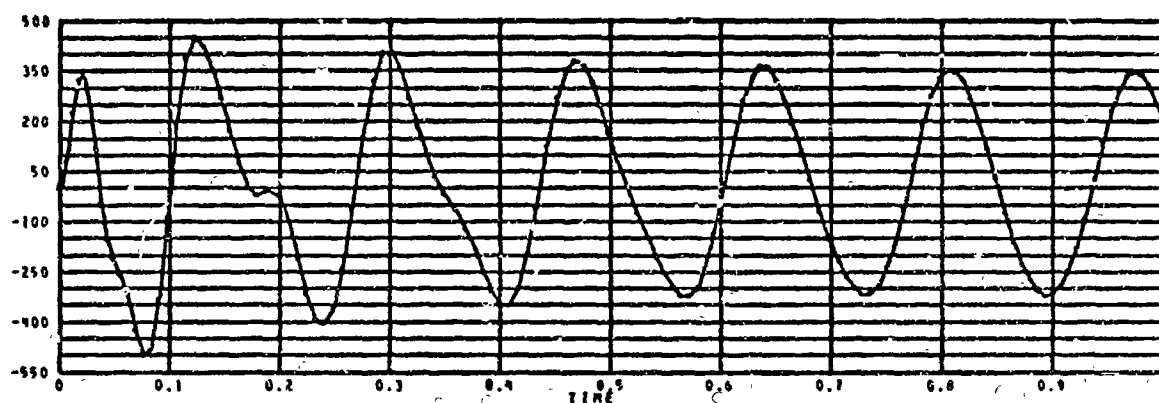
ACTUATOR POSITION ERROR (ACTUAL-COMMANDED)



ACTUATOR POSITION ERROR (ACTUAL-COMMANDED)



NET FORCES ON ACTUATOR PISTONS



NET FORCES ON ACTUATOR PISTONS

